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EDITORIAL NOTES—GAS, &c.

Cause and Effect.

THE first accounts of the London Gas Companies for the past half year to come to hand for review were those of the South Metropolitan Gas Company. The time of their issue is normal; the circumstance of being first abnormal. The report and accounts, we think, will be received with much satisfaction by the proprietors who consider them as a whole, and do not allow judgment to rest solely on the first paragraph of the Directors' report. While this paragraph tells the naked truth, the Chairman (Mr. Charles Carpenter) and his colleagues have not in it done themselves nor the working of the half year complete justice. It informs the proprietors that, in order to pay the full, and excellent, dividend at the rate of £5 9s. 4d. per cent. per annum, it is necessary to take £7350 from the undivided balance; leaving £85,209 to be carried forward. It also mentions that the Directors consider this result satisfactory; having regard to the fact that the extra cost of coal consequent on the passing of the Mines (Eight Hours) Act amounted in the six months to £22,690. To the lay proprietor whose penetration of affairs does not proceed beyond the final result, these two facts, barely stated in conjunction, may not, having regard to their relationship, appear to afford much ground for satisfaction; seeing that the Mines (Eight Hours) Act has apparently come to stay, and, under the circumstances (which taken in their entirety were not bad for gas undertakings) of the past half year, it has necessitated the withdrawal of £7350 from the undivided balance. But those proprietors who are accustomed to investigate the accounts to ascertain the true inwardness of things will consider the relation of the income of the half year to expenditure, and the nature of the latter. These proprietors will note with peculiar satisfaction that though the total expenditure (£830,377) was £52,682 more than it was in the corresponding six months of 1909, the total income (£1,030,374) increased by £31,701—the difference between the two increases being, in round figures, £21,000. Having regard to the amount of this difference, they will (excluding for the moment consideration of the question of coal) note with further satisfaction, having an eye to stability and to the future, that on repairs, maintenance, and renewals—on the works, in the district, and on the fittings on hire in consumers' houses—the Directors were able to spend no less than £38,749 more than in the December half of the preceding year, and yet only have to withdraw £7350 from the undivided balance in order to pay the full sliding-scale dividend. The report remarks, in a later paragraph, in reference to repair and maintenance charges, that they "are still heavy"—the explanation being that "extra ex-"penditure has been incurred in bringing up to date depart-"ments where requirements have outstripped facilities, and "the advantages accruing therefrom will be felt in the "future." This statement and the figures quoted have to be read in conjunction with the opening statement of the Directors' report.

Taking now the item of coal, there is in it at once matter for gratification and regret. Regret lies in the increased cost; the gratification in the fact that, although the current contracts for coal had to be made at an increased cost of nearly 10d. per ton on the previous year's prices (owing to the effects of the iniquitous and impolitic Act already mentioned), representing on the quantity of coal carbonized in the six months the £22,690 referred to in the Directors' report, the actual increase in the expenditure on coal (the total being £340,203) was only £8122, in comparison with the second half of 1909. Had the average price per ton for 1909 continued to rule, the cost of the coal carbonized in the half year under review would have been many thousands less than in the half year with which comparison is made, instead of several thousands more. But, as it is, the co-partners generally—the consumers, and the ordinary and employee proprietors—have to thank the progressive improvement in working in the carbonization department for reducing the effects of the additional cost of coal to as low a figure as £8000 on the aggregate used. As a matter of fact, the working has been brought to such a high state of efficiency that, half year by half year in recent times, the high-road of gas-manufacturing economy—lessened use of raw material, with increased gas production—has been successfully followed, without deviation. In the past six months, the quantity of coal carbonized was 7525 tons less, while 57,118,000 cubic feet more gas was produced. These, coming upon prior successes, are imposing figures. The total quantity of coal carbonized was 555,680 tons, as compared with 563,205 tons in the second half of 1909; while the quantity of gas made was 6,681,496,000 cubic feet, as compared with 6,624,378,000 cubic feet. At the same time the carbonizing wages—£44,774—are, per unit of production, the lowest on record for the Company; being less by £3128 than in the comparative half of the previous year.

But to revert to the make. Per ton of coal carbonized, it is equivalent to an average of 12,024 cubic feet; while in the corresponding six months it was 11,762 cubic feet. The Chairman of the Commercial Gas Company (Mr. W. G. Bradshaw) was referring last August, with no small amount of pride, to the fact that, of the three London Companies, their own average make of gas per ton was the highest—then, 11,946 cubic feet. At the time it was remarked in these columns that we did not think the Horseferry Road and Old Kent Road would allow the challenge implied by the boast to go undisputed; and the topping of the figure by the South Metropolitan Company during the last six months is the first reply. We shall be curious to see the average production of the Commercial Company on this occasion. It will be remembered by our readers in the Provinces that the three London Companies have now to comply with the same illuminating power standard and conditions of test, excepting that, in the comparison, the Gaslight and Coke Company have to bear their calorific power test in addition to the illuminating power one. Associated with make is sale; and the South Metropolitan Gas Company had an increase of 0·78 per cent. in the past half year. It is common knowledge that men who deal with big figures have a habit of putting a different weight upon the adjectives they employ in relation to them than other people who handle smaller sums and quantities. This 0·78 per cent. increase is referred to in the Directors' report as a "slight" one. On turning to the volume figures, it is seen that 6,302,746,000 cubic feet of gas were sold, which was an increase on the corresponding half year of 49,043,000 cubic feet. There are many gas men who will look on an increase in six months of roundly 50 million cubic feet as anything but slight. But the Directors modify in a measure the qualifying term by pointing out that the 0·78 per cent. increase is upon a period when the returns were very favourable. In the second half of 1909, the increase in gas consumption was 4·12 per cent.; and not only has this been maintained, but the 0·78 per cent. has been added. Causes are readily traced for the difference in the percentage rates of increase. Before last Christmas, the weather was mild; and in the winter months the demand for gas for heating plays an important part in the accounts—the day consumption going up and down with the thermometrical variations. The consumption-reducing effect of the inverted incandescent gas-burner is another factor that has an important bearing on the winter long-hour lighting consumption. It is noteworthy that in the Michaelmas quarter of last year, the receipts of the Company for gas went up by £5636; while in the Christmas quarter, there was a decline to the amount of £4355—comparison being made with the corresponding quarters of 1909. The figures go to show how thoroughly the risings and the depressions of the peak heads of the winter gas business are dependent on atmospherical conditions. One other figure regarding consumption. It is remarked that, omitting the quantity of gas used by the Company on the works and eise-

where, the amount of gas sold per ton of coal carbonized was 11,342 cubic feet, as contrasted with 11,103 cubic feet in the December half of 1909.

The points we have dealt with constitute the real features of the report and accounts other than the items in the latter referring to residual products. The bulk of the increase in income is from this quarter; coke and sulphate of ammonia being the dominant contributors, notwithstanding the smaller production of coke owing to the reduction in the quantity of coal carbonized. Owing to the better conditions ruling in the cement trade, the Company have not had to send so much of their coke production abroad. This again is satisfactory. The total revenue from coke amounted to £160,059; being £19,963 more than in the same half of the previous year, though 20,848 tons less were sold. Tar and tar products, in a total yield of £31,392, gave £681 more; while sulphate of ammonia (£61,306) returned £6817 more. Encouraging also is the rate at which new gas connections have been made. The number of slot-meter consumers has risen by 8651 compared with twelve months ago; slot-meter stoves, by 7714; and the gas-fires on hire, by 2973. The revenue from gas-fittings (£41,420) is £1902 more than in the second half of the preceding year.

We will not go farther into the accounts. But sufficient has been said to show that the impression the lay proprietor may get on being introduced to the results of the half-year's working with the words "By taking £7350 from the undi- "vided balance brought forward," will rapidly vanish before the revelations of the revenue account to those who trouble to investigate it. Revelations of the kind are, to those accustomed to the reading of gas accounts, the signs of administrative ability and robust technical working.

Operating Economies of the Heavy Charge.

For no new method in industrial or other operations can its author claim that, from its inception, it comprises all possible details, and nothing more can be done to perfect or to improve upon it. We have come to accept the heavier charge and the longer duration carbonization in horizontal retorts as offering material advantage such as cannot be rejected by any progressive gas engineer, in the financial interests of his concern. But with the acceptance of this material advantage, it was impossible to say there was full knowledge of all the advantage that reposed in the new method. Time only can make full disclosure. As experience proceeds, it is seen that there is much advantage in the method that was latent at the outset of its application; and that it has opened the way to yet further developments that will realize economy. A system that costs less in working and gives an equal return in product, is good; a method that shows both economy in working and a larger yield, represents progress of a composite order that must be marked as excellent. We have this in the heavier charge and longer duration carbonization; but a complete grasp of their potentialities has yet to be obtained.

This is indicated by one of the most studious endeavours, as reflected in an article by Mr. G. M. Gill published to-day in our columns, that has been made by a gas engineer to pass beyond the face-value of advantage, and to ascertain what are the additional capabilities that the system offers in the way of change or development. There is much more knowledge to be brought to book on the subject than is commonly thought; and this can only be done by discriminating and specially directed work such as that which Mr. Gill puts before us to-day, and which we feel sure, will give a fillip to investigation in other quarters. In the first place in the article, there is information that, taken as a whole, may be regarded as a warning. It is not sufficient for a gas manager to say (as some have said): "I will "adopt heavier charges, and twelve-hour carbonization," without paying any regard to retort conditions. The sectional area of existing retorts limits the width and thickness of the charge; and the dimensions of the charge, using high temperatures, must be one factor in governing the duration of the carbonization period. It is manifest that without some relation between weight of charge and carbonization period, there may be, while advantage in make per ton is gained, a tangible waste of economy. As far as possible, taking into consideration all other contributory points, this has to be avoided. It is clear that one requirement now is investigation specially directed to the size and the shape of retort best suited to twelve-hour carbonization at high temperatures, consideration being given to the character of the coal. This is the sort of investigation that could proceed synchronously in different parts of the country in the larger gas undertakings.

But there will probably be the keenest interest in the portion of Mr. Gill's article where he deals with the economy that the heavier charge effects in the matter of labour-saving; and we think that to him must be passed the credit for an attractive innovation, made possible by twelve-hour carbonization, in regard to labour with horizontal retort-settings—at all events, we do not recall a case in which the system has been tried before with horizontal retorts, though possibly German experiences with vertical retort and chamber working may have supplied suggestion. Mr. Gill recognizes certain disadvantages with the twelve-hour charge; but his investigation has led to the conclusion that the balance of economy is in its favour. Further, experience convinces that there is a substantial financial gain to be made by, in medium and small-sized retort-houses, where twelve-hour carbonization and eight-hour shifts are the vogue, to eliminate one of the shifts, and then work only two eight-hour shifts. Visions of variable quality and other things that the gas manager seeks to avoid by the present conditions of working, will arise. Under Mr. Gill's conditions at one of the stations of the Commercial Gas Company, he is fortunate in having two retort-houses; which enable him to so arrange two eight-hour shifts in each that work is always proceeding in one of the houses. The economy of labour that has been effected, as shown by a tabulated statement in the article, is remarkable. One rises from consideration of the article that Mr. Gill presents with a feeling that, with a twelvemonth's experience at his back, he has safely established his case—showing super-advantage from the change to two eight-hour shifts with heavy charges and twelve-hour carbonization—before presenting it for the consideration of his colleagues.

Provisional Orders.

Solid (including the Liverpool Corporation) for the No. 2 Burner.

In this week's issue, we complete the review of the gas legislation for the forthcoming session of Parliament by giving final notices of the Provisional Orders that have been lodged at the Board of Trade, the Local Government Board, and at the Scottish Office. Looking generally over the five articles constituting the review, there is one striking feature, and that is the common consent among gas companies and gas-works owning local authorities that the day for gas of *per se* high luminosity is dead, and that the lowest limit at present recognized as a standard by Parliament, and included in the Model Clauses—viz., 14-candle illuminating power, tested by the "Metropolitan" No. 2 burner—is the right one to be adopted. The next step should be the cancelling entirely of the illuminating power standard, and (as Parliament are not likely to take that course without having something to substitute) the setting-up of a calorific power one. But Parliament have not been so rigid in the matter of the 14-candle power as they were at one time in declining to descend below the lines established in the long years of flat-flame burner supremacy. In the instalment of the review of the Provisional Orders published this week, the Longford Gas Company are suggesting a 12-candle power standard tested by the "Metropolitan" No. 2 burner. There is not the shadow of a reason why, to-day, the Company should not have that for which they ask. Parliament have supplied precedent in the past two sessions. In 1909, the Bury Corporation were allowed a 12-candle standard; and last year the Middlesbrough Corporation. These two important local governing bodies—custodians of the interests of the people who placed them in authority—recognize the absurdity of the illuminating standard in these times, and in their applications went as far down in the scale as they thought they might tempt Parliament to consent to, next to revoking the standard altogether, and putting a calorific power one in its place. From these two great towns, from numerous towns granted lower standards and the "Metro- "politan" No. 2 burner last and several previous sessions, there has come no bitter cry as to degraded gas and higher accounts. The phantoms of an interested opposition have completely disappeared into the obscurity from which they were raised, beaten back by the experience that has been running through the country.

Casting the eye down the notices of the Provisional Orders published last week and again this, it will be remarked that the prescription of the 14-candle standard as tested by the

"Metropolitan" No. 2 burner is sought by nearly every one of the promoting Companies—a notable instance being the Preston Gas Company. It is patent that application for the change to a lower standard and current testing conditions (taking advantage of the opportunity for securing a few other modern provisions) by way of Provisional Order is, considering the number of Orders to be dealt with this session, regarded as a simple mode of procedure. The consistent success of the Standard Burner Acts of last session has unquestionably given a fillip to these applications; and running over in mind the violent opposition that those measures received up to it seems almost but yesterday, the rapid conversion of the Liverpool Corporation to the "Metro-politan" No. 2 burner presents itself as a remarkable instance of the susceptibility to transformation of human nature and the human virtues. The Corporation are owners of the gas-works supplying the consumers of Fazakerley; and their gas has hitherto been tested by the use of a batswing or fish-tail burner. They are asking this session to be empowered to substitute the "Metropolitan" No. 2 burner in testing the gas, using the burner in accordance with the conditions and regulations as laid down in the Standard Burner Acts. We can well understand the absurdity of continuing a flat-flame test-burner, when all the rest of the city and district is being supplied with gas tested by the "Metropolitan" No. 2 burner. But if we entertained any belief in the dreadful things that were going to happen to gas consumers of Liverpool and elsewhere—whether supplied by companies pictured as being almost without conscience, or by misguided local authorities—then we should shudder for the future of the consumers of Fazakerley gas, and the powerful Corporation, who were instrumental in bringing most deplorable conditions upon their defenceless heads, would descend by leaps and bounds in our estimation. But the contrary is the case. We admire the wisdom and the boldness of the Corporation in coming forward so soon, and admitting their mistake—costly and abortive though that mistake proved to be to themselves and to those local authorities who lined themselves up in opposition to the No. 2 burner last session at the mere beckoning of the Liverpool Corporation. This Liverpool Provisional Order, for the one purpose of getting authority to use the "Metropolitan" No. 2 burner, is "the "last straw to break the camel's back" on which opposition to the burner has been making its ponderous and futile attacks. There can be no more of it without it is met by the derision of all who view, in a commonsense way, the affairs of the gas industry prospectively.

There are several instances of stand-by clauses in the Provisional Orders, as in the Gas Bills reviewed in preceding numbers of the "JOURNAL." Some have reference to stand-bys in the case of private gas installations only; while others also apply to premises having electricity supplies. The North Pembrokeshire and Petersfield Orders deal with both; and in their case, too, as in the Tamworth Bill, there is a clause exempting the Companies from the obligation of giving a supply of gas where suction-gas plant is the usual source of power, if it is likely to interfere with, or jeopardize, the supply to regular consumers. A somewhat similar clause, it will be remembered, appears in the Swansea Bill.

In a few instances, a disposition is seen, no doubt for very good reason, to require in some particular an amendment or amplification of the model prepayment meter clause. In the Provisional Orders, there is the Clay Cross Company asking for 1s. 1d. excess for meter and fittings (instead of 10d.), 1s. 3d. (in place of 1s.) if a cooking-stove is added, and 20 per cent. on the cost of a coin meter (instead of 10 per cent.) where only a meter is installed. In the Holyhead, Llanrwst, Llangefni, and Pwllheli Orders—all four of common origin—the 1s. excess with cooker is omitted. There may be recollection, too, that in the Enfield Bill the Company show they will be content with a level 11d. maximum excess for a prepayment installation, whether or not a cooker is fixed. In the Cannock Order, the Company require their relations with the consumers in regard to the possession of the money in the meter-box to be defined. They desire that it shall be enacted that the money "shall "be deemed not to have been paid by the consumer to the "undertakers until the undertakers or their collectors have "actually received it." There are other instances where it is thought proper to protect a company against dormant capital in prepayment installations and the caprices of people in requesting installations and then not using them, by the power to demand a deposit from the consumers of 1s. per quarter—the amount collected each quarter to be first used in refunding the 1s. to the consumer; but where there has been no use of the gas to provide the money for refunding the deposit, this will then belong to the company. There is more than one company this session asking for exemption from liability to damage caused by reason of the non-repair of any meters—prepayment or otherwise—or fittings let out on hire by them, unless notice of the want of repair has been given in writing to the company, and there has been neglect to repair within a reasonable period.

The evidence of local authorities looking upon gas undertakings as eligible possessions is continued in the case of the Provisional Orders. The Cudworth Urban District Council have been taking gas in bulk from the Barnsley Gas Company; and they now have a fancy for having their own manufacturing plant. The Chipping Norton Corporation are also desirous of taking part in wiping out the Mid-Oxfordshire Gas Company (one of the promotions of the Preston group), and passing its very name into oblivion, by entering upon the business of gas suppliers, and taking over the local undertaking from the Liquidator. But it is palpable that the Corporation have very positive notions as to the value of the property, in view of their position under section 161 of the Public Health Act, 1875, and that of the Mid-Oxfordshire Company as a concern devoid of parliamentary power. It will be remembered that the Bicester District Council have a Bill in Parliament to empower the acquiring of the local concern, which is also a part of the ill-fated Mid-Oxfordshire scheme. In the Longford Order a purchase clause appears in favour of the local authority, operative in any one of three consecutive sessions. There are no other special points that call for observation, if this article be read in conjunction with the preceding ones dealing with the projected legislation for the session.

High-Pressure Gas in Industry.

WE cannot too highly compliment the Birmingham Corporation Gas Department upon the sound and complete methods that have been established for developing business in high-pressure gas heating among the industries of the city and district. The lines (described in other columns) are those leading to success, through proved economy and efficiency. It shows commercial acumen of the highest order that determines, in a new venture of the kind, that there shall be a no haphazard growth of application, but that step by step there shall be scientific foundation and *raison d'être*. Observation and practical experience can carry one far in work of this character; but combine scientific investigation and devising with observation and practical experience, and this will carry one much farther, and more immediately and directly along the road to certainty, economy, and efficiency. This is the view of Mr. R. S. Hilton, the Secretary and Manager of the Corporation Gas Department; and the Gas Committee, who are men of business and men of affairs generally, have freely endorsed it.

At the very beginning of the scheme for applying high-pressure gas to industrial heating, it was resolved that it should in no wise be marred or checked in its progress by improper application or failure to achieve all it was firmly believed it was capable of doing. To that end, as foreshadowed in our columns three months since, it was decided to give to the industrial high-pressure business a *quasi* independent existence, by providing it with separate premises, with laboratory and demonstrating room, where investigation and development could be made, and consultation and advice between manufacturers and the chief of the laboratory could proceed unimpeded. It was very essential that a scientific man who had shown special ability in heat research should be selected as its head; and the Committee were fortunate in securing the services, in this capacity, of Mr. E. W. Smith. Already the laboratory is established in its new home; already high-pressure gas heating has been proved to Birmingham manufacturers to possess virtues of which they were not cognizant. Heating efficiency, adaptability, ever-ready application, quickly realized and uniform temperatures, reproducible temperatures, adjustability of temperatures, cleanliness, increased output, time-saving, and reduced cost are among the merits of the method of heating that have been demonstrated, and are being talked about in the city's industrial circles. The elements of success expand almost daily; and development is leading to development. In the short space of its existence, good work has been done by the laboratory in devising and advising; and there is plenty more to be done.

Industry is a big thing; and heat and its applications are growing requirements. There is much to be accomplished for gaseous fuel to fully occupy the industrial heating field already in existence; and there is the work necessary for keeping pace with the developments of demand. We do not know the limits of economy and efficiency of high-pressure gas in the sphere of industry. But we do recognize that they are afar off; and science is the best means of guiding us along the road.

The sanguine expectations of the Birmingham Gas Department are being realized in a very encouraging manner; and the prospects are good. All concerned in it intend to press forward. Upon the new work there, the professional men of the gas industry are keeping an eye. It is an interesting, pioneering development from which there is much to be learned; and the influence of it all will, we venture to think, before very long, take material shape in some other industrial centres.

Inverted Burner Heads.

In the discussion of the question of the maintenance of incandescent burners, the point as to whether or not glassware should be included in the fixed charge to consumers (where free labour is not in operation, and all materials are specially charged for) has frequently been raised; but experiences are so diverse that no general agreement at present appears to be possible. The patterns, colour, decoration, and so forth, of the glassware, too, have such an extensive range nowadays—a range that is to be welcomed rather than deprecated in order to please consumers, and to secure harmony with the surroundings in a room or other place—that the question is thereby very much complicated. It is not, however, the controversial point as to the propriety or otherwise of including glassware in any maintenance scheme that, on this occasion, engages attention. It seems to us that some inquiry is necessary as to why there are such diverse experiences with glassware—more especially of inverted burners. We have come to the conclusion that the mode of constructing the heads of this form of burner is largely responsible for this; and the view is founded on a fairly extensive experience with a number of different types of burners.

From this experience, it seems that making gas-burners with metal heads that have too close a relationship with the glassware is a mistake. Several inverted burners have been in use with the globe support constructed of a light band carried by diagonal pieces from the upper part of the burner, and with a space between the globes and the band, and long screws for support. In the case of six burners out of ten so constructed, there has been no renewal of the glassware for four years. With another type of inverted burners of which extended trial has been made, there is an ornamental metal head over the top; and this is so formed that the lower edge is ornamented all round by leaf-like extensions, through three of which the screws are carried. The whole of the projecting parts of this leaf-like pattern are close to the upper rim of the globe, though not pressing upon it, but there is more contact (however much care is taken to place the globe in a centrally uniform position) than is desirable. In the case of these burners, the breakages of glassware have been more frequent than is pleasant. The globes first crack round the rim. The cracking—and this is important—occurs after the lights have been extinguished; and subsequently the mornings have constantly found the globes in pieces at floor-level. All sorts of shapes and makes of glasses have been tried, with the same result. Glasses out of the same batch as those that have given such excellent life and service on the other burners have been tried on these metal-topped burners with the lower part of the metal hood in close proximity to the globes, with the same result. The particular burners referred to are not the only ones that have shown a bad record with glassware, nor are the burners first alluded to the only ones that have presented a good record.

These observations and experiences seem to point to two things as accounting for the destruction of the glassware. The metal tops get very highly heated, and so long as the burners are in use no damage is occasioned; but the proximity of the metal top to the glassware, and the inequality in the rate of contraction of metal and glass on cooling after the light has been extinguished, is apparently the cause of the cracking and ultimate destruction of the glass. The happy experience with the globes on inverted burners of various constructions where the former are kept well out of contact with a highly heated metal hood, lends confirmation to the view. Where metal hoods are used which become highly heated, lips or projections from them, perhaps with a band well away from the globe, and long screws should evidently be provided. At all events, we submit that the point is worth consideration by the burner makers, as to how far (if at all) the construction of the heads of burners is responsible for an undue destruction of glassware. The inverted burner has earned a good name for lighting efficiency and for gas and mantle economy. The reputation must not be spoilt, in any make of inverted burner, by complaints as to the glassware expense and unreliability. The fact that experiences, by those accustomed to the handling of incandescent burners, show that there are constructions of burners that are not destructive of the glasses, is sufficient ground for saying that burner-head design can contribute either to the satisfaction or the contrary of the consumer in respect of his globes. Perhaps some gas-burner makers will like to express their views on the subject in our "Correspondence" columns. If so, we shall be pleased to hear from them.

Gaslight Report and Accounts—Lower Coal Prices.

Just as the "Journal" was being prepared for press yesterday, the report and accounts of the Gaslight and Coke Company were received, but too late to make a studied examination of their contents for this issue. They will therefore be dealt with next week. The report and the accounts are reproduced elsewhere; but the most cursory glance suffices to show that the Governor (Mr. Corbet Woodall), his colleagues, and all concerned in producing the results have to be very heartily congratulated upon them. Further substantial progress has been made, both financially and technically. The dividend of £4 13s. 4d. has been earned with a good lump sum to spare. After meeting all capital and other obligations, the carry-forward will be advanced by £83,318 (to £625,688), though repairs and maintenance, especially in the distribution department, have claimed a goodly amount in addition to the expenditure under these heads in the corresponding half of 1909, taking into the reckoning for that period the items for West Ham. The large carry-forward is an act of prudence. There is a penny reduction of the price of gas to be considered from the beginning of this year; and 1d. reduction on the private consumption alone now means upwards of £100,000 per annum. The proprietors and the employee partners will also expect to share with the consumers in the prosperity of the concern. The consumption of gas during the half year has increased by 3 per cent. The prospects are good. Contracts for a large proportion of the coal requirements for next year have been entered into (earlier than customary) at prices below those for the current contract period. Then, too, it will be remarked that the number of consumers and gas-stoves continue to climb in luxuriant fashion. The Directors also look hopefully for the maintenance of the vigour that has been displayed in the residuals markets. The half-year's tale is an excellent one; and looking outwardly from the position at which the record closes, considerable satisfaction is derived from what is seen.

Studies of Light Standards.

It is not a little curious that the subject of standards of light should occupy a rather prominent place in several of the early numbers of the present volume of the "Journal," and that for this we should be indebted to the American Illuminating Engineering Society. We began with the interesting paper presented at the fourth annual convention of the Society by Dr. E. B. Rosa and Mr. E. C. Crittenden; this was followed by a report of the remarks to which the communication gave rise; and in the current issue will be found practically the whole of an instructive outline of the early history of light standards, presented by Mr. E. L. Nichols at the meeting of the New York Section of the Society last month. Dr. Rosa and his colleague recorded the results of their investigations into the working of Hefner and pentane lamps; but the paper must be regarded as only a preliminary report on their work. Fuller details will appear in the "Bulletin" of the United States Bureau of Standards, in which they hope to be able to furnish additional reasons for the variations existing between the lamps named. They say that while much remains to be done to render the pentane lamp a thoroughly satisfactory flame standard, they are greatly encouraged by the progress made

so far; and they believe that a much closer agreement between different lamps, and a slightly higher degree of reproducibility in the same lamp, are possible. In their opinion, with the exercise of a little care, the unit of light can be fixed with very considerable precision with either the Hefner or the pentane lamp. The paper by Mr. Nichols, given elsewhere, is of an entirely different character; being, in fact, a review of what had been done in the way of producing standards of light up to the date of the introduction of the Hefner amyl-acetate lamp. Though there is nothing new in this paper, taken in conjunction with the other it forms a useful contribution to the literature of an interesting subject; and the two papers may be commended to the attention of those (especially the juniors) who wish to learn something about the work of the early photometrists, and of those who are investigating the results of the work of their successors.

Increasing Work of Local Governing Bodies.

The question of the ever-increasing tendency on the part of Parliament and Government Departments to add to the duties of local governing bodies, without making any attempt to provide the necessary funds for carrying them out, is one that has been drawn attention to on various occasions of late; and a few days ago it was the subject of a strong complaint on the part of Lord Lichfield, when addressing the Staffordshire County Council. As he remarked, referring to certain of these duties, Parliament had decreed that they should be carried out; and all they as a Council had to do was to provide the money for doing so. He expressed the hope that the Finance Committee would in no measured terms protest against the trend of events at headquarters in recent years. It was, he went on to say, not a political question at all, but one of preserving the true spirit of local government, so that those who were called upon to administer local affairs would at least be allowed to arrange what they thought fair and right. As matters now were, the Councils had to get the money from the ratepayers; but there was certainly not the least doubt that if successive Chancellors of the Exchequer had had to provide some portion of the additional expenditure incurred during the last ten years or so, there would not have been half so many changes. Every year, it was pointed out, the proportion of grants has tended to diminish in relation to the amount of rates that has had to be collected to carry on local government. To a deputation of the County Councils Association, the Prime Minister expressed great sympathy on the question; but there has seemingly not been any resultant relief to the rates from the Consolidated Fund. Perhaps when ratepayers feel inclined to grumble at the demands made upon them, they will bear in mind the remarks of Lord Lichfield, who thinks it only right that they should clearly understand who are responsible for a considerable portion of the increased burdens which they now have to bear. Perhaps, even, they will see that it is to their interest to fall in with his view that they should all unite "in trying to preserve what little there is left of the powers of those who have to direct local affairs, so that in future there may be some further check than there has been in the past on the action both of Parliament and of the Government Departments." The complaint made does not, of course, impugn the necessity, or even desirability, of the new duties from time to time placed upon the shoulders of the local governing bodies, but is solely directed to the important question of whether the local ratepayers should directly bear the whole burden of them.

Jubilee of Mr. Henry H. Salomons.

On the 21st prox., Mr. Henry Hyman Salomons, the Engineer-in-Charge of the Brussels station of the Imperial Continental Gas Association, will complete fifty years' connection with the Association. In celebration of this event, the Chairman and Directors will entertain him at a dinner to be given in Brussels, which will also be attended by the Managers of the other works of the Association. Mr. Salomons entered the service of the Association in February, 1861, at the age of sixteen, as pupil-engineer at Antwerp. He was transferred to Toulouse in September, 1866; to Bordeaux in June, 1869; to Antwerp in November, 1876; and to Vienna (Baumgarten) in April, 1878. In July, 1879, he was appointed as Engineer-in-Charge at Haarlem; and in May, 1884, he was entrusted, in addition, with the supervision of the Rotterdam station. In November, 1888, he was appointed as Engineer-in-Charge of Amsterdam, being relieved of his duties at Rotterdam; and in December, 1898, he was made Chief Engineer-in-Charge of the works at Brussels. On the occasion of the Directors' dinner, a gold watch, suitably engraved, will be presented by them to Mr. Salomons as a *souvenir* of the event; and next day a presentation will be made to him by his colleagues on the engineering staff.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 331.)

Business on the Stock Exchange was quieter last week. It was account week; and the settlement, though offering no apparent difficulties, was heavy enough to call for considerable attention. Things moved rather irregularly, and without very much serious change either.

A prominent feature was the continued strength of all the gilt-edged lines, and especially of Home Railway secured issues. Another strong quarter, and one more particularly interesting to our industry, was the conspicuous strength of Gas stocks. The opening day was a quiet one; and already an eye was directed towards the approaching settlement. Prices were scarcely so firm. Government issues were dullish, though Consols did not move. Rails were uneven; but some speculative lines looked brighter. There was still much repose about business on Tuesday. Gilt-edged stocks were steady, Railways quiet and devoid of feature, Americans shifty, and the Foreign Market colourless. On Wednesday, some of the best quality were lower. Consols lost $\frac{1}{8}$ and $\frac{1}{4}$ for the account; but Railways were firm. Thursday was cheered by the lowering of the Bank rate, which had not been universally expected. Consols recovered, many others improved, and even Rubbers became quite lively again. Friday was mostly very quiet, except where realizations upon recent smart rises imparted activity. The gilt-edged group were firm. Consols rose $\frac{1}{4}$; but Railways were lower on sales. Saturday was quiet and rather dull. Consols lost half their rise; and in speculative quarters there was some relapse. Rails, however, were better. In the Money Market, there was a strong demand for short loans, and discount rates hardened until after Thursday, when the Bank rate was lowered to 4 per cent.

Business in the Gas Market throughout the week was not more heavy in point of volume, but everything touched was very firm; and it was gratifying to note a better tendency in debenture stocks. In Gaslight and Coke issues, the ordinary was strong and active, with transactions ranging from $106\frac{3}{4}$ to $107\frac{1}{2}$—a rise of $\frac{1}{2}$. In the secured issues, the maximum was a point higher at from $86\frac{1}{4}$ to $87\frac{1}{4}$, the preference realized from 104 to $104\frac{3}{4}$, and the debenture $78\frac{1}{2}$ and 79. South Metropolitan was very quiet and steady at the old figures of $121\frac{1}{2}$ to 122. In Commercials, the announcement of (subject to audit) a higher dividend brought about many dealings in the 4 per cent. stock at $110\frac{1}{2}$ to $114\frac{3}{4}$ (a rise of 2); and the debenture marked 78. Among the Suburban and Provincial group, Brentford new changed hands at 200 (a rise of 2), British at from $44\frac{5}{8}$ to $44\frac{7}{8}$, Bromley "B" at $89\frac{1}{2}$, Ilford "B" at 116, and (on the local Exchange) Liverpool "B" at $164\frac{3}{4}$. In the Continental companies, Imperial was done at $185\frac{1}{4}$ to 186, Union at 91 (a rise of 1), European fully-paid at $24\frac{3}{4}$ *cum div.*, and Tuscan debenture at $98\frac{1}{2}$ and 99—a rise of 1. Among the undertakings of the remoter world, Cape Town debentures were dealt in at $88\frac{1}{2}$, Monte Video at $12\frac{5}{8}$, Primitiva at from $7\frac{3}{8}\frac{5}{2}$ to $7\frac{1}{8}\frac{3}{2}$, ditto preference at from $5\frac{1}{4}$ to $5\frac{1}{8}\frac{5}{2}$, San Paulo at $15\frac{1}{2}$ and $15\frac{5}{8}$, and ditto preference at from $11\frac{7}{8}$ to 12.

ELECTRICITY SUPPLY MEMORANDA.

A Scotch Circular and its Misrepresentations—Power Costs—Mantle and Metallic Filament Lives—Gas "Fumes" and Fuming Electricians—When Sinners Entice—Effect and Uniformity—That Pat of Butter.

It completely baffles our understanding how electricity purveyors would set about trying to reconcile the need for misrepresentation with all the loudly proclaimed meritorious attributes of electricity from the point of view of economy onwards to the use of electricity being the one essential to promote health and to prolong life far beyond what was the common span of man's days when gas stood practically alone as the illuminating agent among all excepting the very poor, and when the general sanitary conditions in our urban districts were not so good as they are to-day. With all the boasted virtues of electricity, the purveyors have to indulge in the meanest of claptrap in order to secure business. The Clyde Valley Electrical Power Company have been guilty of this, and of, we deliberately assert, pure fabrication in endeavouring to drive forward their business in Barrhead. A copy of a circular issued by them has reached us; and we want to put a few direct questions to the Company, and to ask them to substantiate their dogmatic statements by reply in a manner equally definite to that adopted in their specious and delusive circular.

Among much else, we see this Clyde Valley Company do not like the light-for-light basis of comparison, because they know that, on the side of gas the product shows superiority in economy, and that it is maintainable by simple and expeditious means. They call it an "abstruse" calculation. We are sorry for the amount of intelligence that the use of the word displays. It is also stated in effect that, during the proceedings on the Glasgow Corporation Gas Bill last session, it was brought out in evidence that, with electricity at $3\frac{1}{2}$d. per unit and gas at 2s. per 1000 cubic feet, as in Glasgow, "without lower rates, gas could not compete effectively with electricity." We ask the Clyde Valley Company from which gas engineer's evidence such a deduction can fairly be

drawn. We ask them, too, whether the evidence generally (not the alleged statement) was not directed to the question of differential prices for power and industrial purposes, and not, as it would seem from their circular, to lighting. We are very interested in this matter, and so are anxious to ascertain, if the Company will oblige us with chapter and verse, the extent of the justification for (whoever is responsible for it) the sheer misrepresentation; and the officials of the Company are surely aware that it is so. They know as well as we do, or if they do not then they do not know their business, that with an ordinary gas-engine a brake-horse-power-hour will only cost for gas 0·36d., with gas at 2s. per 1000 cubic feet; while with electricity at 1d. per unit, the cost per brake-horse-power-hour will work out to 0·80d. Multiply the difference by horse power, and by the number of hours use per annum, and a substantial saving will be the result. People engaged in industry have also to consider other things besides cost. There is the question of reliability; and the numbers of failures of electricity supply that there are in the country during the year might well make any manufacturer or tradesman pause before committing himself and his business to such an uncertainty. We recollect how keenly the Editor of the "Worthing Gazette" was recently bemoaning his ill-fortune in having placed the printing of his paper at the mercy of an electric motor; successive failures on printing days having turned the first infatuation into deep resentment and reproach. Then the reports of the Chief Engineer to the British Engine, Boiler, and Electric Insurance Company, Limited, have shown year after year that the ratio of breakdowns to number of electric motors and gas-engines insured is much greater in the case of the former than in that of the latter, though the motors as a rule are more modern than the engines. When the question of convenience is considered apart from all else, it is admitted that there are a few purposes for which electric motors have an advantage over gas-engines; but the latter, on the other hand, have in most instances many substantial advantages over the former.

The next point upon which we accuse the Clyde Valley Company of deception is in referring to 2000 hours as the working life of a metallic filament lamp, as though that was a fair figure to take as an average. The Company know, just as well as we do, that in an installation the metallic filament lamps that succeed in being transmitted from the makers and in getting safely lodged at the point at which their service is to be rendered, have varying lives, according to bad or good fortune, from a few to many hours; but, normally, nothing like 2000 hours can be claimed as an average life. We should like to know, therefore, what justification they can put forward for using the figure of 2000 hours in the way they have done. Then, again, we ask the Company for the ground on which they state that there is an immediate severe drop in the efficiency of a gas mantle, and a further drop of at least 25 to 40 candle power after a few months' use. We will take an inverted mantle, for instance, and invite the Company to explain what mysterious action in connection with the chemical constituents of the mantle occurs that depreciates the efficiency in the outrageous manner suggested. Perhaps the Company will send us a sample of the mantle to which they refer, in order that it may be tested. The depreciatory statement has obviously been made not for the critical examination of people who know the characteristics of incandescent gas mantles, but for the purpose of deceiving the householder. The same thing applies to the relative cost of maintenance of incandescent mantles and of metallic filament lamps. It is sought to show that mantle maintenance costs per burner in ordinary households 2¼d. per 100 hours' use. That is untrue. We fail, too, to see how the statement can be reconciled with the point as to the drop of candle power referred to "after a few months' use." But it is manifest that the sole object of these various arbitrary figures is to make mantle maintenance work out to the cost of the maintenance of metallic filament lamps with the hypothetical average life of 2000 hours. This will not do. Reduce the average life to an approximately proper figure, and even the extraordinary figures of the Company for mantles will show an advantage on their side. Still we should like to see what sort of case the Clyde Valley Company are prepared to make in vindication of the misrepresentation.

Then in the circular there is another deliberate falsehood. Nowhere has it been stated by anyone in the gas industry that "gas *fumes* are more conducive to health and ventilation than the unpolluted air of electrically equipped premises." This is a subtly suggestive sentence. In the first place, it infers that there are emissions from the combustion of a free burning gas-flame that are detrimental to health. It will be of interest to learn what the emissions are. It will also be of interest to hear what the Clyde Valley Company have to say to one of the leaflets issued by the Electricity Publicity Committee, advocating the use of electricity for lighting, and, in close connection, also declaring that the use of an electric fan is indispensable for keeping the house healthy. This is not astonishing. There is no doubt the Electricity Publicity Committee recognize fully that the carbon dioxide given off by human respiration and perspiration is heavily laden with harmful organic matter, while the amount of carbon dioxide given off by the small amount of gas necessary for incandescent gas-burners is harmless. They also most probably recognize (though they do not advertise the fact) that, unlike the gas-flame, the electric lamp has no power to act destructively upon these organic products of human respiration, and does not assist in creating circulation of the air. It is very strange, too, when one considers the palaver of electricians about poisonous gas fumes, as gas is consumed under modern conditions, that we have not heard of the medical men in those fashionable quarters of London where electricity was adopted for lighting in days before gas lighting attained the refined conditions of the present time, having to pass through the bankruptcy courts, or having to remove to the workhouse, nor have we come across any marked increase (as there should have been assuming the electricians are correct) of notable cases of longevity in those fashionable quarters. The electrical argument is not justified by the result. Regarding the quotations in the circular from the "Electrical Review," as to the adoption of gas in the meeting and exhibition rooms of the Society of Medical Officers of Health, that weekly champion of electrical interests had a smart rap over the knuckles from Dr. Reginald Dudfield, the Chairman of the Committee, who had been entrusted by the Council with the supervision of the new heating, lighting, and ventilating arrangements, when he said, at a meeting of the Society, that he considered it beneath their dignity to pay any attention to *ex parte* statements published in the electrical trade press. He added that "*no member who had experience of their meeting-room under the old conditions could deny the improvement that had taken place since gas had been substituted for the electric light and the new system of heating and ventilation had been installed.*"

We shall look with interest to the reply of the Clyde Valley Company, if they have the courage to come out into the open, and deal with the criticism we have thus advanced of their advertising methods.

The London Electric Supply Corporation and the Westminster Electric Supply Corporation have seriously fallen out over the question of competition. There is litigation pending; so that the present is not the time to say anything much about the matter. But according to the "Electrician," plaintiffs desire to restrain defendants from (as alleged) "enticing away their customers." The "Electrical Review" states that the object is to restrain the defendant Corporation from "influencing the plaintiffs' customers." The lines of the allegations can be left for explanation when the trial comes on, in about a fortnight's time; but there is a spice of humour about the affair when we consider how by fair means the gas industry is ever trying to entice away customers from the electrical industry, and how by in some cases fair and in others foul means the electricity industry is ever trying to entice away the customers of the gas industry. We hope that the case will be fought out.

In an article by Mr. Kenelm Edgcumbe, in the "Electrician," he presents some tests that he has made of the experimental gas and electric lamps in Gower Street. We do not know precisely what is the object of the article just at the time the Committee of the Holborn Borough Council are considering the whole matter. It may be to induce the Committee to believe the candle power of the gas-lamps to be above that of the metallic filament lamps. We contend it is quite the other way about—that the Electric Light Company's lamps are far and away beyond the illuminating power per lamp prescribed for the experiment, when measured between the specified angles; and that is obviously in order to outshine the gas-lamps. Mr. Edgcumbe says that the gas-lamps he tested averaged 475-candle power, while the electric lamps were of 430-candle power. His measurements were taken at 3 ft. 3 in. from the ground; the specification mentions at the "ground level." With regard to the candle power attributed to the gas-lamps, tests conducted by a gas-testing expert, and according to the specification, show results of from 330 to 340 candles; so that Mr. Edgcumbe's figure for the gas-lamps is higher than this by about 50 per cent. But he declares that, though the candle power of the gas-lamps is greater than that of the electric lamps, the latter show a considerably better distribution. The minima of the two forms of lamps are practically the same, according to Mr. Edgcumbe's tests—*i.e.*, about 0·07 foot-candle. But the maxima are widely different—that of the electric lamps being about 0·35 foot-candle, and of the gas lamps 0·7 foot-candle, or just double. We are not going to squabble over the figures at the present time. But they do serve to remind of the "Electrical Times" outdoor lighting number of last October, in which, speaking of intensity, the writer urged electricians to push home the point for all it was worth as to not sacrificing "effect" for "monotonous uniformity." That was before Mr. Edgcumbe made his experiments, and when electricians from visual examinations saw underneath electric lamps a large body of light, and such a little that they were ashamed of it but a little distance off. We do not like the rapid chameleon-like changes of our electrical friends.

No elaborate pyrometrical investigations, which the public do not understand, but a couple of little pats of butter have done much in proving to the good people of the City of Canterbury that the gas radiator and the electric radiator have nothing in common in the matter of heating efficiency. The Gas Company have run gas and electric lamps in their show-room side by side, and metered the consumption of each, so that all may behold, and the municipal electricity suppliers cry out if they are unfairly injured by the tests. The consumption and cost results have formed the matter for striking advertisements in the local papers; and all Canterbury has been as interested in what has been going forward as Epsom and Newmarket are in the events with which their names are honourably associated. The economy of the incandescent gas-burner was demonstrated by the public trials at Canterbury. Then came the gas and electric radiators. A pat of butter was placed in front of each. The public saw the one in front of the gas-fire quickly liquefied; while the heat from the electric radiator had scarcely any effect on the pat placed

in front of it. That was popularly convincing. The temperature and cost results from a twenty-four hours' test (Jan. 18) were:

	Area Heated. Cub. Ft.	Increased Temperature.	Net Cost.	
Electric radiator	210	12°	3s. 0d.	at 1½d. per unit.
Gas radiator	240	22°	0 10	at 2s. 9d. per 1000 cub. ft.
Difference in favour of gas	30	10°	2s. 2d.	

On this subject of heating, a writer in the "Electrical Times" says he "must express the opinion, after fourteen months' test with nothing but convectors and radiators to furnish warmth throughout his house, that while electric heating is ideal for the bedroom, drawing-room, and for rooms which are not in use for many hours at a time, it is at present, with energy at 1½d. per unit, too expensive for living rooms. A room measuring 18 feet by 14 feet by 10 feet high, with bay window, cannot be warmed effectively in cold weather with less than 1500 watts going continuously. With an initial temperature of 45° Fahr., a rise of 8° is secured in such a room in an hour and a half; and every additional hour raises the temperature another degree—the maximum being about 58°." After waiting all day for the room to get comfortably warm, bedtime must be welcome.

MANTLE MAKING AT HOME.

A Profitable Scheme——for the Promoters.

THERE seems to be a little money-making game afloat in which gas-mantle finishing at home is the occupation offered to those who chose to buy from the promoters of the scheme the appliances, and the materials for doing the work, and then resell the mantles to the same people at a profit of 2s. per 100, out of which 2s. there fall to be paid for the gas used, and the cost of carriage on quantities of less than 1000, or half the carriage on quantities of not less than 1000—the balance of the modest 2s. being the recompense for time and labour expended. Or if the home workers chose to dispose of the mantles to local retailers, they may—in fact, the circular before us says they would find no difficulty in so disposing of them—make a profit of upwards of 7s. 6d. per 100 mantles. But assuming local retailers are not willing to risk their reputation and business on the home-made product, then there is no alternative for the mantle makers but to fall back on the bountiful offer of the promoters of this scheme and take the 2s. per 100—paying themselves out of it, if they can, for time and labour, after deducting the cost of gas and carriage. It looks as though the home-mantle maker would do as well, if not better, by devoting himself or herself to crossing-sweeping. Certain it is the only people likely to make any substantial profit out of this pretty little venture are those who sell the appliances and the materials to those who devote their leisure time to this unprofitable occupation.

The promoters of the scheme are the Incandescent Supply Syndicate, 2, Gray's Inn Road, Holborn, E.C.; and on their circular they describe themselves as "manufacturers, patentees, and specialists." We have not the shadow of a doubt about the applicability of the last-named description. Introduction to their scheme is obtained through the following advertisement:

> £3 WEEKLY easily earned, making gas mantles at home; free tuition.—Address envelope, Incandescent Supply Syndicate, 2, Gray's Inn Road.

This advertisement has not appeared in the "JOURNAL," though if it were worth while to engage in the manufacture of mantles apart from the firms who specially devote themselves to this work, surely gas companies and gas committees would be the ones likely to take up the work, being themselves large users, and therefore not being encumbered by the necessity of finding a market for the product of their enterprise. But they find it better to make choice of those mantles that are produced, under expert supervision and proper conditions, by the expert hands that are constantly engaged in the work.

The seductive advertisement having induced an application to the Syndicate for particulars, a printed circular is received, from which we learn that the Syndicate are good enough to offer to teach the applicant, "free of cost, a trade, which, within a short time, *may* enable" him or her "to develop a big business by selling the mantles to us with good returns." Overleaf we see the statement that, "after deducting expenses for gas and carriage, 1000 finished mantles, if sold to us, will bring you upwards of £1 *clear* profit." It has already been shown that it cannot possibly do any such thing. If one wishes to see a demonstration of the process of making mantles before deciding to purchase the tools, &c., the Syndicate make a deposit charge of 5s., which is returnable when the work is proceeded with; otherwise, we suppose, it is "good-bye" to the 5s. These good people expect to receive from those who take up their benevolent offer (one might imagine this a philanthropic institution) their best endeavours; also that they will devote to the work as much time as is convenient, though, in regard to this point, the Syndicate "do not make any stipulations." What brilliant thoughtfulness! They have also—thus further showing how considerate they are—arranged the process of manufacture on the most simple lines to enable large quantities of mantles to be made with the least trouble and difficulty. To this end they supply the webbing already impregnated. By this means, with little experience, there is no reason, so it is said, why one should not turn out thousands of mantles in one's spare or whole time during a week. Though the webbing is impregnated, the self-sacrificing Syndicate supply the "formula free of cost, with all particulars in writing necessary for making the mantles, and teach the process by personal demonstrations as often as necessary to make you proficient in the work."

The rates the would-be mantle maker has to pay the Syndicate for appliances are as follows:

High-pressure burner, complete with rubber hand controller	£1	1	0 each.
Wooden shaper	0	2	6 ,,
Glasses	0	1	6 ,,
Hooks	0	1	0 doz.

We do not know what the high-pressure burner is like, with rubber hand controller, for £1 1s.; but 2s. 6d. for a wooden shaper appears steep. However, these are the appliances; now for the "raw" materials necessary for the work:

Impregnated webbings	10s.	0d.	per 100.
Collodion, flexible	3	0	a quart.
Boxes, with outers	1	6	per 100.
Total cost of "raw" materials for 100 mantles	14s.	6d.	

The Syndicate pay 16s. 6d. per 100 for cash on delivery; so that there is, as said, 2s. per 100 from which the worker has to pay for the gas used, carriage on quantities of less than 1000, and recompense himself for his time and labour.

We hope the advertisement that we have given to this piece of enterprise on the part of the Incandescent Supply Syndicate will not induce any one of our readers to take up this work in order to profitably employ his spare hours; and at the same time it might be mentioned that we have no particular desire to come across any of these home-made productions. We also have an earnest hope that the Syndicate will not find many (if any) "Dear Sirs or Madams" who are silly enough to think there is money in this project for them. And in all sincerity we wish the Syndicate a short life, and an unprofitable one.

SHOCK TESTING MACHINES FOR MANTLES.

THE paper recently read by Messrs. J. H. Coste and W. E. F. Powney, on the "Testing of Incandescent Mantles," has drawn fresh attention to the Woodall-Moon machine for the testing of the resistance of mantles to various shocks [*ante*, pp. 82, 97, and 172].

One of the oldest, if not the oldest, of this type of machine is that devised by Dr. Drehschmidt, of Berlin, of which a brief description was given in the "JOURNAL" [Vol. LXXXIII., p. 34] in the report of the proceedings at the Second International Photometric Congress, held at Zürich in 1903. The machine was then favourably spoken of by Professor H. Bunte. A totally different mode of testing mantles—for tensile strength as well as for elasticity—was brought before the same congress by M. Th. Vautier, of Lyons, and was described in the same number of the "JOURNAL." Another mode of testing the tensile strength of mantles had a short time previously been described by M. Syssoyeff [see "JOURNAL," Vol. LXXXII, p. 449].

The "Zeitschrift für Beleuchtungswesen," of Oct. 20 last, recalled attention to the Drehschmidt shock-machine, by giving a descriptive article and illustration of it, as now made by the firm of Paul Altmann, of Berlin. The article points out that the testing of the durability of mantles has now become of greater importance in Germany than formerly because the recently imposed tax on mantles has rendered them more costly to the consumer; and large consumers, such as public lighting authorities, now commonly test the supplies that are offered, in order to select only those brands and consignments which the tests indicate should have a long life.

The Drehschmidt shock machine for testing mantles is used by the Berlin gas undertaking; and the mantles used by that authority for the public lamps have been reported to have an exceptionally long average life, having regard to the conditions in which they are employed. Since the Drehschmidt machine was first devised inverted mantles have come into use; and an adaptor is now provided with it, so that both upright and inverted mantles may be tested. The shock-testing machines are useful to manufacturers as well as users of mantles, because they disclose at what part the mantles are most fragile; and improvement may then be directed specially to this part.

Another shock testing machine in use in Germany is supplied by the firm of Sensenschmidt, of Frankfort-on-the-Maine [see "JOURNAL," Vol. CVII., p. 181].

Among prospective arrangements for the present session of the Liverpool Engineering Society (under the presidency of Mr. Edward Allen), we learn that on Feb. 8 Mr. H. James Yates, F.C.S., of Birmingham, will read a paper on "Coal Gas as Fuel," and on March 22, Mr. Samuel Glover, of St. Helens, will deal with the question of "Developments in Gas Making."

THE GASLIGHT AND COKE COMPANY.

THE following is the report on the working of the Company during the six months ending Dec. 31, which, with the accounts (an abstract of which appears on p. 321), will be submitted to the proprietors on the 10th prox.

The accounts for the past half year show that, after providing for fixed charges, setting aside £10,000 towards the redemption fund, and contributing £20,000 to the insurance fund, there remains a profit balance of £460,838 11s. 2d. The amount brought forward from the previous half year being £542,370 3s. 10d., there is a total sum available for distribution of £1,003,208 15s., out of which the Directors recommend a dividend on the ordinary stock at the rate of £4 13s. 4d. per cent. per annum, which will absorb £377,520 7s. 8d., and leave the sum of £625,688 7s. 4d. to be carried forward to the credit of the current half year.

The sales of gas for the half year show an increase of 3 per cent. compared with the quantity sold during the corresponding period of 1909.

There has been an increase during the six months of 16,671 consumers, and of 32,022 in the number of gas-stoves sold and let on hire.

The Directors have the pleasure to announce that a further reduction of 1d. per 1000 cubic feet in the price of gas—viz., from 2s. 8d. to 2s. 7d.—was made at the beginning of this year.

Taking advantage of the favourable condition of the coal market, the Directors have anticipated the usual period for making contracts, and have purchased a large proportion of the coal which will be required in the year ending June, 1912, at rates less than those for the current period.

The market for residuals of all descriptions has been strong; and the prospects for the future in this direction appear good.

A Bill in Parliament has been deposited to authorize the acquisition by the Gaslight and Coke Company of the undertakings of the Barking Gas Company and the Chigwell, Loughton, and Woodford Gas Company, to confer further powers on the Gaslight and Coke Company, and for other purposes. An extraordinary meeting of the proprietors will be held immediately after the ordinary general meeting, when the provisions of the Bill will be explained, and, in compliance with Standing Orders, the Bill will be submitted for the approval of the proprietors.

The Court of Directors has been furnished by the several engineers of the Manufacturing and Distributing Departments respectively with the usual certificates that all the Company's works and plant have been maintained in thorough efficiency.

CORBET WOODALL, Governor.

Horseferry Road, Westminster, S.W., Jan. 19, 1911.

SOUTH METROPOLITAN GAS COMPANY.

THE following is the report of the Directors of the Company for the six months ended the 31st of December, which, with the accounts [see p. 322], will be presented to the proprietors at the ordinary half-yearly meeting on the 8th prox.

By taking £7350 from the undivided balance brought forward, the profit of the past half-year's working provides for payment of the full sliding-scale dividend at the rate of £5 9s. 4d. per cent. per annum; leaving £85,209 to be carried forward to the next account. The Directors consider this result satisfactory, having regard to the fact that the extra cost of coal consequent on the passing of the Mines (Eight Hours) Act amounted in the six months to £22,690.

The consumption of gas shows the slight increase of 0·78 per cent.; but as the returns for the corresponding period were very favourable, it is gratifying that the improvement has been more than maintained. The Company's business being one of heating as well as of lighting, the influence of mild winters is necessarily considerable.

Residual products have all appreciated in value; and it is pleasing to report that, owing to the better outlook in the cement trade, it has not been necessary to send so much coke abroad. America continues a favourable market for creosote; and the Company's make of pitch finds a ready sale on the Continent.

The production of gas per ton of coal is the highest in the history of the Company—viz., 12,024 cubic feet; and at the same time the carbonizing-labour costs have been the lowest. Repair and maintenance charges are still heavy. Extra expenditure has been incurred in bringing up to date departments where requirements have outstripped facilities; and the advantages accruing therefrom will be felt in the future.

The popularity of the inverted gas-burner continues to increase; one reason, among others, being the greater durability of the inverted mantles. South London is at present unable to afford the fine street lighting by means of high-power gas lately carried out in Westminster; but its tradespeople have been quick to appreciate its great advantages from the shopping point of view, and have established two remarkable installations at important centres in Streatham and Lewisham, which are giving great satisfaction.

The Company's co-partnership continues with undiminished success. It completed last month the twenty-first year of its existence, during which period the sum of £505,675 has been distributed to the employees in the form of bonus, over and above their wages. But this sum, large though it be, does not equal the gain to the Company in the good feeling, good will, and good work of its co-partners.

The Board record, with great regret, the death of their colleague Captain T. B. Heathorn, whose association with the Directorate dates back 41 years, and who at one time presided over its deliberations as Chairman. Two Directors (Mr. Robert Morton and Mr. John Ewart) and one Auditor (Mr. George Maughan Footner) retire by rotation. They are eligible, and offer themselves, for re-election. Mr. Joseph Newbold has been elected an Employee-Director in place of Mr. Henry Austin retired from the service.

CHARLES CARPENTER, *Chairman.*

709, *Old Kent Road, S.E., Jan.* 23, 1911.

PERSONAL.

Mr. P. E. CULLING, the Chief Clerk of the Cheltenham Gaslight and Coke Company, has been appointed Secretary of the Weston-super-Mare Gas Company.

Mr. EDWIN UPTON, who has been appointed Treasurer of the Liverpool United Gas Company, was on Friday last the recipient of a handsome Chippendale chiming timepiece, suitably inscribed, as a parting gift from his former colleagues in the Bootle Town Clerk's department.

Mr. THOMAS LAYTON, who for thirty years filled the position of Secretary and Manager of the Redditch Gas Company, attained his eightieth year last Tuesday, and was the recipient of numerous congratulations. He retired in 1903, and was succeeded by two of his sons; another—Mr. Walter T. Layton—being in the service of the South Metropolitan Gas Company, of whose "Co-Partnership Journal" he is Editor.

Mr. H. THURSTON OWENS, Consulting Engineer, of New York City, has been appointed Associate Editor of the "American Gaslight Journal." Mr. Owens has been connected with the lighting industry for the past ten years, and has been a frequent contributor to the Technical Press. He is a member of the American Gas Institute, the National Commercial Gas Association, the New York Electrical Society, the American Illuminating Engineering Society, and is a corresponding member of the British Illuminating Engineering Society.

OBITUARY.

The death occurred somewhat suddenly a short time ago, of Mr. CHARLES ELLIOTT, the Manager and Secretary of the Leyland Gas Company, in whose service he had been for about thirty years. He was a member of the Manchester District Institution of Gas Engineers, and also of the Institution of Gas Engineers. Deceased was in his 57th year.

The "Journal für Gasbeleuchtung" reports the sudden death, on the 29th ult., of Herr H. WÖHR, the Manager of the Municipal Gas and Water Works at Heilbronn, which position he had held for the past three-and-a-half years. Deceased had only attained his thirty-eighth year; and prior to receiving the Heilbronn appointment, he was assistant at the Munich Gas-Works.

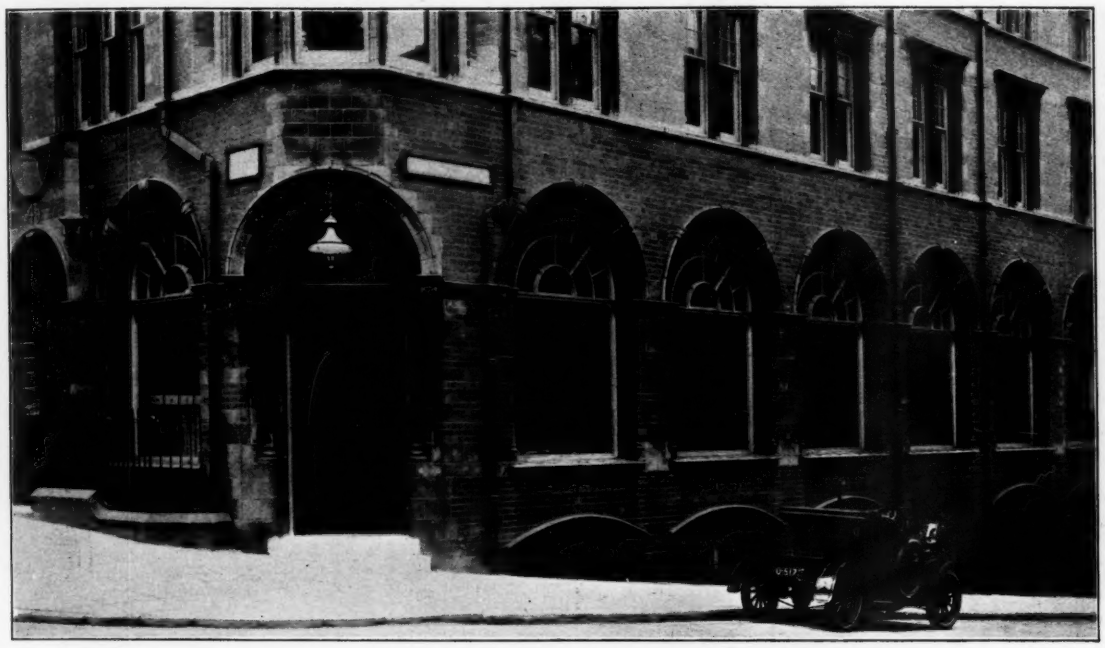
Mr. ROBERT MACFARLANE MITCHELL, one of the leading citizens of Glasgow, for twenty-four years a member of the Town Council of the city, and from 1895 to 1901 the Convener of the Gas Committee, died on Saturday, the 21st inst., in his 67th year. Mr. Mitchell had many qualities which endeared him to his colleagues and to the public. In 1905, he was nominated for the office of Lord Provost of Glasgow, but failed to secure election.

Mr. GEORGE E. SAVILLE, who was the first Engineer and Manager of the Holyhead and North Wales Gas and Water Corporation, Limited, and who relinquished the position a few years ago and commenced practice as a consulting engineer at Southport, died last Wednesday, after a rather long illness. Members of the Manchester District Institution of Gas Engineers who attended the meeting at the close of October last year will recollect that Mr. Saville was then lying in a nursing home after an operation, and sympathy was expressed for him. He leaves three sons, all of whom are managers of gas-works. Deceased was in his 58th year. The funeral took place last Saturday at Todmorden, where for fourteen years Mr. Saville was Engineer and Manager of the gas-works. He was a member of the Institution of Gas Engineers.

We regret to record the death, on Monday last week, at his residence, Wilton Place, S.W., of Captain THOMAS B. HEATHORN, R.A., one of the Directors of the South Metropolitan Gas Company, of which for a time he was Chairman. He served throughout the Crimean War and in the Indian Mutiny campaign, and was a member of the Committee of Armaments of 1868, under the late Sir William Gordon. He had been on the Board of the South Metropolitan Gas Company since 1869; and his father, the late Mr. J. L. Heathorn, was one of the first members of the Board. Deceased, who was in his 81st year, was exceedingly popular with his colleagues and among the employees. The funeral took place at Kensal Green Cemetery last Friday, and was attended by the Chairman (Mr. Charles Carpenter), the Secretary (Mr. F. M'Leod), the Chief Engineer (Mr. W. Doig Gibb), and some of the station Engineers.

HIGH-PRESSURE GAS FOR INDUSTRIAL PURPOSES.

The Development of the Technical and Commercial Work at Birmingham.



General View of the High-Pressure Gas Laboratories.

From an investigation made last week at Birmingham into the technical and commercial progress that the interesting scheme of the Corporation Gas Department is making in developing high-pressure gas heating for the factories of the city and district, there is no doubt that to Birmingham both the gas industry and the manufacturing industries which use heat in their operations will be able to look for much light and leading in the matter of the efficient application of high-pressure gas to this purpose. As we showed in an article on Nov. 1 last, in which introductory information as to the scheme was given from particulars kindly furnished by the Secretary and General Manager of the Department (Mr. R. S. Hilton) and the Superintendent of the Fittings Department (Mr. S. R. Barrett), the Gas Department have exhibited a bold enterprise in this matter—an enterprise all the more noteworthy in that the best modes of applying high-pressure gas to the divers and diverse purposes of Birmingham industry have to be worked out, and manufacturers have to be shown that there is an absolute economy in the utilization for heating of gas at high-pressure as compared with solid fuel, either in direct cost, or through the speeding-up of the work in regard to time and labour, and thus producing an increased capacity, or through both. However one looks at the matter, from whatever direction gains are made, it all means economy to the manufacturer. That is what had, and has, to be demonstrated; and working largely in an unexplored region, work had to be taken in hand *ab initio*. But Mr. Hilton assured us three months ago that the department were so confident that they could be of great service to the industries of Birmingham, that they were not going to take any half-measures in the matter. On the principle that what was worth doing at all was worth doing well, they were going forward with thoroughness. Confidence and resolve are already reaping their reward.

A Separate Technical and Commercial Department.

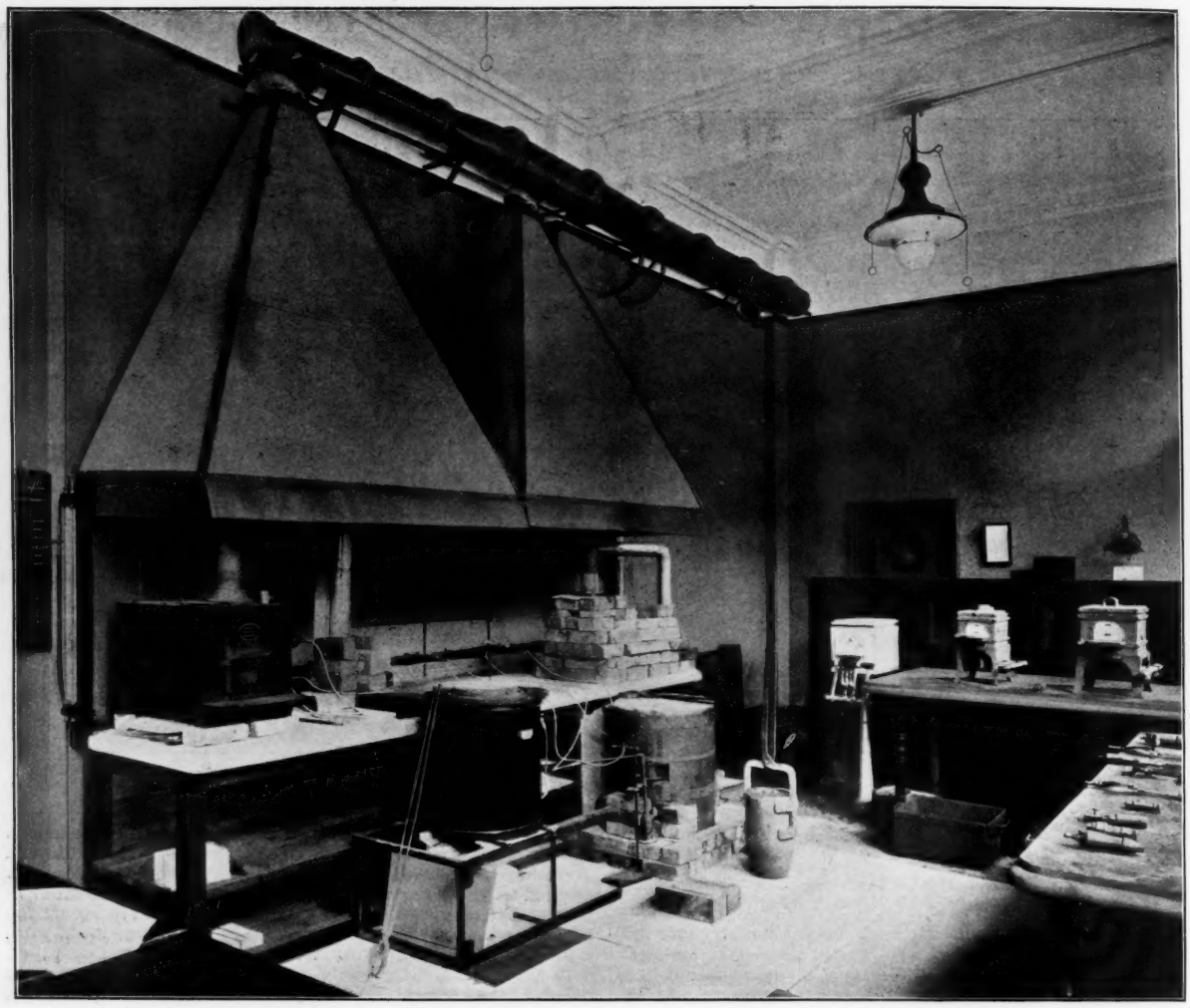
This is not an experiment. It is large and serious business; and, as was mentioned in the course of our former article, it was decided to create a sub-department specially to deal with the application and vending of high-pressure gas, and to engage the services of Mr. E. W. Smith (whose work in connection with Gas Heating Research at the Leeds University has brought him prominently before the gas industry) as the technical head of the department, primarily with the view of developing the best means of application to varied purpose. The Gas Department, in this business as in other branches, believe that success depends upon efficiency; and, holding this view, they have set out with the object of being the guides and friends of the manufacturers, whose patronage, and extent of patronage, will rest solely on what can be accomplished with the gas. This was the view; and the first step has been to establish the high-pressure sub-department in a large suite of rooms of its own at Cornwall Buildings, Newhall Street. There last week we saw Mr. Smith in possession, with his engineering assistant (Mr. C. M. Walter), who was associated with Mr. Barrett in the work at its initial stages, and a clerk. In addition, the Gas Department supply all the fitters, from their regular staff, who are required in connection with any work that is going forward. The whole place is intended for hard work. It is a laboratory and workshop from beginning to end; and it is equipped with the completeness that delights the heart of the man of research. But it is a very practical equipment; and Mr. Smith's work at Leeds has stood him in good stead in making his arrangements. He was practically allowed a free hand in fitting up the premises; and, as the result, we are going to see much useful work come out of this department. Of this we may be sure that, within reasonable limits, the gas industry will be the richer for the work that the Birmingham Corporation Gas Department are carrying out here.

The First Lines of Development.

This is in the main pioneer work. The first need has been to learn the requirements of the industries of the city in regard to heating, and to ascertain what they are doing under their existing circumstances. The designing of furnaces and experimenting as to the economic possibilities—in cost, time, output, and so forth—are of the work. Then giving advice is essential, as to whether a standard type of furnace should be obtained, or, if a special kind is preferable, a specification for it is drawn up, and it is then made. But it should be explained that the department are not in any way competing with the makers of gas-furnaces, muffles, crucibles, and so forth. They are simply acting, as Mr. Smith puts it, as intermediaries; and, as a matter of fact, they are developing, through the combination of science and business acumen, this heating business in a way that the makers of such appliances could not hope to do. The High-Pressure Laboratory, in short, acts in an advisory capacity to the manufacturers; the chief concern being to adapt, in the most advantageous way, the use of gas to industrial ends.

It may be well to explain how the department are dealing with the furnaces. All makers of furnaces have sent to the department their lowest prices for this class of goods; and furnaces are being sold by the department. But the makers have also intimated exactly what discounts they allow their Birmingham customers; and the department are keeping strictly to these prices. So there can be no question of unfair competition. The makers can sell the furnaces through the department, or supply them direct. But whenever they supply a furnace, whether this is done through the department or direct, they send in the Form A,* which is reproduced. In this way the department will get, as it were, a census of all the industrial heating apparatus that is in use in the city and district. Then there is Form "B." A pad of these is given to the foremen fitters of the Gas Department, and the trade is also supplied with them. This is known as the "inquiry return sheet;" and when the foremen or the trade meet, in the course of their work or business, any manufacturer who inquires about high-pressure gas heating, and who wants to go into the matter, one of these return sheets is made out, and sent to the High-Pressure Laboratory, and communication is at once opened up, investigation made, and information given. It is the Fittings Department that do the actual canvassing; the High-Pressure Department then follow the matter up. The form marked "C" is a card on which a record of all details of every installation is

* For convenience of re production in our columns, the forms (pp. 287-8) that we call "A," "B," and "C" are set smaller than the originals.



Main Demonstrating Room, where Furnaces are Built to Special Designs to Show how Worked.

"A" FORM.

CITY OF BIRMINGHAM GAS DEPARTMENT.

Reference Number	
Ours	Yours

HIGH PRESSURE LABORATORY,
CORNWALL BUILDINGS,
NEWHALL STREET.

TRADER'S RETURN OF FURNACES.

Name of Firm_____ Date_____

Address_____ Manager's Name_____

Nature of Business carried on by Firm			
Type of Furnace Ordered or Purchased		Inner Dimensions	
Catalogue No.		Temperature Reqd.	
Gas Consumption per furnace per hr.		Number of furnaces to be used.	
State whether Furnace is "High Pressure," "Natural Draught," or "Air Blast"			
Does the Firm wish to consult the Laboratory?			
Other Information			
Name of Furnace Maker		Signature of Firm's Representative	
Representative's Name			

"B" FORM.

CITY OF BIRMINGHAM GAS DEPARTMENT.

Reference Number	
Ours	Yours

HIGH PRESSURE LABORATORY,
CORNWALL BUILDINGS,
NEWHALL STREET.

INQUIRY RETURN SHEET.

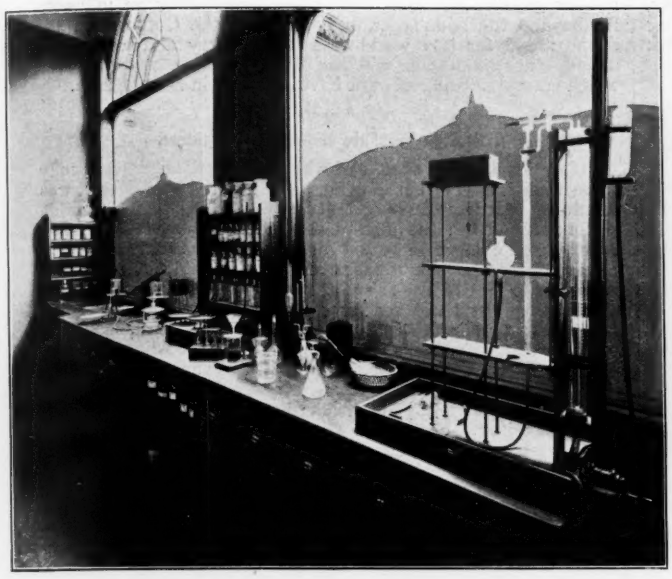
Name of Firm_____ Date_____

Address_____ Manager's Name_____

Nature of Business carried on by Firm	
Nature of Inquiry	
Does the Firm wish to consult the Laboratory?	
Name of Representative making this return	

kept for immediate reference when required. In these methods of developing and watching over the business, the department is very completely organized, and system runs throughout.

But up to the present time there has been no special advertising or circularizing of the high-pressure gas business. It has, so to speak, been developing itself on the recognition by manufacturers of the advantage of having a cleanly fuel always available, of remarkable heating power, and a fuel that may be depended on for maintaining uniform temperatures, and always when required reproducing precisely the same temperature, and, in addition, providing economies and gains. Already there have been designed



Private Laboratory—Showing the Bone and Wheeler Gas Analysis Apparatus.

Testing One of Bryan Donkin's Pressure Governors.

and put into use, or about to be put into use, 60 to 160 lb. brass furnaces, aluminium furnaces, annealing furnaces, tool-hardening furnaces, gum-boiling furnaces, "glory hole" furnaces, oil-boiling furnaces, button-colouring furnaces, bone button furnaces, and all kinds and sizes of blow-pipes for the jewellers' quarter. Present and known prospective customers certainly number between thirty and forty; and already there is an absolute certainty of an annual increase in consumption of many million cubic feet of gas, and on the horizon are seen great expansion possibilities.

The New Centre.

The centre of activity of the High-Pressure Laboratory where Mr. Smith and his staff and their equipment are housed, is admirably situated and suited to the purpose. It commands an imposing position in Newhall Street, within handy reach of the Gas Department's Offices at the City Hall; and therefore, apart from telephonic communication, there is ready access to the Chief of the Gas Department (Mr. Hilton). Outside, at night time, there is a high-power high-pressure lamp alight, which cannot fail to attract attention immediately one turns into the street. The suite of rooms comprises the main demonstrating room with office, the private laboratory, workshop in basement (with lathe and tools complete), a store-room for accommodating material, &c., on which experiments are to be made, and other conveniences are seen necessary for the work to be prosecuted.

The Demonstrating Room.

Looking first round the main and spacious demonstrating room, it is noticed that it is very appropriately fitted with two high-pressure lamps, the illuminating power of each of which is 900 candles—the gas being supplied from the high-pressure main, and governed down to about 40 inches water pressure. On either side of the room are arranged benches. The two wooden ones, under the long range of windows, are covered with uralite; and on the opposite side of the room is a stone bench, on which the work of developing furnaces, determining suitable pressures, and demonstrating efficiency is carried on. While making inspection, Mr. Smith and his assistant, Mr. Walters, were busy determining the pressures, air supply, flue draught, and other points requisite for the heating of a temporarily constructed "glory hole," for examination by the technical head of one of the manufacturing firms in the city. To this stone bench, there is a supply of gas at a pressure of 10 lbs. to the square inch. There are all the necessary fittings for connecting up the mercury gauges; the pressures being taken from just before the burners. Over the bench are a pair of uralite hoppers (as seen in the illustration); these being in communication with a horizontal flue near the ceiling (composed of ordinary earthenware drain pipes), through which flue the products are extracted by means of a Keith-Blackman fan situated in the adjoining corridor; and this passes the products into an ordinary chimney, which is now used solely for this purpose. [The same drain-pipe flue, it may be parenthetically remarked here, is used for a similar ventilating hopper fixed in the private laboratory.] At the top of each hopper, there is a valvular arrangement so that it can be cut out, and regulated at will. By cutting one out, a greater air velocity can be obtained with the one in use. The area of hopper at the middle is 8 square feet: and the velocity of the air at half speed centrally in the hopper is about 70 feet per minute. But it is possible to get 140 feet per minute. All the necessary accessories for the work (they need not be here particularly specified) are ready at hand.

This, then, is the room in which the large-scale experimental work goes on. It is the room in which demonstrations are made to possible users and customers. No trouble or time is denied to the work of development, even to the construction of special furnaces for conditions for which the types on the market are not suitable. Here can be demonstrated copper, brass, and other metal melting, glass melting, annealing of all kinds, tool hardening, and bronzing. Mentioning bronzing reminds of an illustration. The High-Pressure Section were asked recently to design a furnace to displace the hand blowpipe method of bronzing. One was designed; and an expert of the firm interested visited the place to give it a trial. It was shown that, by the high-pressure gas system, any number of articles (depending upon the size of the furnace) could be bronzed in from half a minute to three minutes, according to the character of the work, whereas previously it had taken a girl three minutes to do each article. This is only one out of several instances of the economy secured. In another case, seven furnaces were designed for one firm for gum boiling, it being necessary in this particular instance that the whole furnace should be enclosed, as any boiling over of the gum or varnish would be fatal.

"C" FORM.

Name of Firm_____ Manager's Name_____ Reference No.

Address_____

Telephone No. _____ Date_____

Class of Work	District No.
Particulars of Furnace	

H.P. N.D. or A.B.	No. of Furnaces.	Dimensions of Furnace.	Jets.		Type.	Crucible.	Consumption per Furnace.	Pressure at		T °C required.	Date of Inst'n.	Diameter of		Ref. No.
			Dia.	Number.				Jet.	Meter.			Service.	Supply.	

Among the incidental points gathered in conversation with Mr. Smith were that work is carried on here at pressures varying (purpose being the controlling factor) between 100 and 300 inches of water. One special point is the method that the laboratory after experiment has adopted in regulating heats. Instead of cutting down pressures, they reduce the number of burners in use, maintaining the fixed pressure to the remaining ones—in other words, it is found preferable to cut out a burner rather than reduce pressure; and the burners themselves are so arranged as to enable them to do the work most efficiently. The burners that Mr. Smith has come across, designed for high-pressure work, do not appeal to him as being most suitable; and therefore he has, with his assistant, designed one, in which simplicity and range of application are the striking characteristics. Its chief feature is that it enables the gas, on any increase of pressure or *vice versâ* being desirable, to pull in a correspondingly increased or decreased proportion of air; whereas in other burners, in which there are what may be called expansion chambers in the tube, an increase of gas pressure will not correspondingly enlarge or diminish the amount of air drawn in. With the new burner uniform temperatures can always be maintained. The construction of the burner (which has been provisionally patented) is very simple. The tube carrying the gas nozzle is movable in the framework that carries it, so that the nozzle can be adjusted as desired nearer to or farther from the point of combustion. Nozzles with different sized aperatures are also made, varying according to the character of the work to be accomplished. The framework carrying the burner tube and gas nozzle supports a mouthpiece, the interior of which is conical in form, being made at an angle that experiment has determined to be the best for air adjustment. The mouthpiece past which the combustion takes place is finished off with a fire-clay shield. The high-pressure gas injects into the free space formed by this open mouthpiece; and the adjustment of the gas nozzle to it determines the quantity of air drawn in. It is a convenient and simple burner, designed to do hard work, and, as has been witnessed, it is highly efficient, and its range of application is considerable.

Among the high-pressure heating appliances always in stock for demonstration purposes are such things as high-pressure soldering-irons, laundry irons, blow-pipes, muffles, and the usual type of furnaces; and, as previously stated, the laboratory are ready and willing to undertake for their possible customers any investigation in constructions of appliances out of the ordinary run wherever special distribution and degrees of heat are desirable.

The Private Laboratory.

In the main private laboratory are to be found the same types of high-pressure gas arrangements with the ventilating hopper over a stone bench. Alongside is a glass fume chamber, in which was seen safely installed a special balance. At hand are the electrical connections for operating and controlling the fan. A Bone and Wheeler gas analysis apparatus forms part of the equipment. There is air under blast and air under suction. On the opposite side is a 15-feet teak bench, with cupboards and drawers, all very nicely fitted and got up. Looking round at the less imposing, but necessary equipment in the room, there is a carbon combustion furnace; and there are mercury gauges, barometer, pyrometers, Féry radiation pyrometers, galvanometer, and a thermo-junction combination. The gas pressures, it is learned, are always maintained in the laboratory at 23 inches mercury gauge. Free use is made in the fittings of flexible steel pipe, with gun metal adapters. The whole room is thoroughly well lighted, both in daytime and at night. And while speaking of light, we are reminded of heat. The suite of rooms is heated throughout by hot-water radiators; supplied by two of Messrs. John Wright and Co.'s "Garajo" gas-heated boilers, suitably disposed in the basement.

In the laboratory proceeds all the scientific work which is the real foundation of the practical application of gas, either high or any other pressure, to industrial heating. Here, too, various engineering problems necessitated by the new method of distribution are investigated—such as new high-pressure meters, governors, and cocks—as well as new high-pressure lamps. By-the-way, it has been found necessary to have a special meter designed for the high-pressure supply; and this has been devised to stand a test up to 30 lbs. per square inch. Then there is work to be done on the flow of gas at very high pressures through pipes of varying diameters. This is, it must be remembered, a "private" laboratory; and only the complete results of the work can be made public. That is to say, the results of the research work will be used for the benefit of the Department's customers; but at the same time the makers of gas furnaces and the gas industry generally will, there is every reason to believe, reap of the fruit of the investigations undertaken. The laboratory principally lives for the consumer, and in order to place the business firmly on the bases of economy and efficiency.

A Few Specimen Costs.

As examples of the cost economies achieved, it may be mentioned that it has been found that the expenditure for melting copper aluminium alloy with high-pressure gas is approximately 0·05d. per lb.; while previously, it is stated, it cost with coke, 0·25d. A ton of brass, too, can be melted up at a cost of 8s. 6d. per ton; whereas with coke it costs anything between 10s. and 13s. 6d.

The organization of the laboratory and of its work has been started well. They are the lines to success, and to an enduring and progressive success. This success will carry an influence far beyond the boundaries of the area of the Corporation gas supply; and for it a world-wide gas industry and world-wide manufacturing industries will owe a debt to the pioneering work which enterprise and foresight have set going in Birmingham.

The High-Pressure Distribution System.

Before leaving this sketch of what is being done, readers may be reminded that, in our previous article on the subject, it was mentioned that there were installed at the Windsor Street works, in connection with the high-pressure distribution scheme, two Worthington compressors; and these will be extended as demand necessitates. The compressors are each capable of supplying 60,000 cubic feet of gas per hour at 15 lb. per square inch pressure. Altogether there are at present 7 miles of high-pressure mains laid; 3½ miles being 12 inches in diameter. This length of pipe runs to King's Norton, and is also used for boosting purposes for the general supply of gas. The pressures vary from 10 to 18 inches mercury, or 7½ to 10 lbs. per square inch; and these are governed-down to any point required. The whole of the mains are of cast iron. For the high-pressure supply, special cocks, gauges, meters, and, in fact, everything requisite in this way, had to be specially designed.

To keep themselves precisely posted as to what is being done in the high-pressure business in the district, maps of the area have been specially prepared, showing in red the high-pressure mains, and the places where connections have been made. In areas where there are no high-pressure mains, the department are advising the use of small compressors. These when installed will be marked in blue on the maps; and when a sufficient number are fixed to justify the laying of a high-pressure main, the compressors will be taken out, and a main put in. The compressors will be the pioneers. This is an interesting detail in the development of the high-pressure business.

THE QUALITY OF LONDON GAS

In the Year 1910.

Articles which appeared in the "Journal" last year [Vol. CXI., pp. 98, 179, and Vol. CXII., p. 248] gave particulars of the results of the official testings made of the quality of the gas supplied by the three Metropolitan Gas Companies during the first three quarters of the year. It is now proposed to give similar particulars for the fourth quarter, and a summary of the results for the whole year, with the corresponding figures for the years 1908 and 1909 by way of comparison.

Fourth Quarter of 1910.

The figures relate to the thirteen weeks ended Dec. 31, 1910; as to 1908, to thirteen weeks ended Dec. 28; and as to 1909, to fourteen weeks ended Jan. 1, 1910. They are taken from the weekly summaries published by the London County Council of the results of testings made by the Gas Examiners in 19 testing-places prescribed by the Gas Referees. The testings made in three similar testing-places within the City area are not included in these reports.

Illuminating Power.

The average results for each Company of the testings of illuminating power, both with the standard No. 2 "Metropolitan" argand and with the prescribed flat-flame burner, are shown in Table I. As compared with two years previously, the argand results for the Gaslight and Coke Company show a reduction of 2·03 candles, which corresponds almost exactly with the reduction of 2 candles (from 16 to 14) in the prescribed illuminating power which was sanctioned by the Company's Act of 1909. The South Metropolitan Gas Company have succeeded in effecting in two years a reduction of almost exactly one candle in the average illuminating power of their gas; while the Commercial Company have made no appreciable alteration. The fall of 2·03 candles in the average argand value of the Gaslight and Coke Company's mixed gas has been attended by a fall of 3·44 candles in the average candle-power obtained in the flat-flame testings; while the fall of 0·99 candle in the average argand value of the South Metropolitan Company's coal gas has been attended by a fall of 1·41 candles in the average of the flat-flame results. The flat-flame testings of the Commercial Company's supply show substantially the same results in the three years. The minimum results of the argand testings reported for the fourth quarter of 1910 were 13·49 candles for the Gaslight and Coke Company, 14·09 for the South Metropolitan Company, and 13·18 for the Commercial Company. The prescribed illuminating power for all three Companies is now 14 candles; but if the deficiency is less than one candle on any one day, the mean of the results recorded for that and for the preceding day and the following day is to be taken as the illuminating power for the one day. Hence, as the minimum results of 13·49 and 13·18 candles each relate to a single day's testings only, it is improbable that the two Companies to whose gas they refer have rendered themselves liable to any forfeiture in respect of them. The South Metropolitan

Company's gas has proved well above the 14-candle standard on all occasions.

Calorific Power.

A summary of the results of the testings of calorific power in the fourth quarter of each year is given in Table II. It will be seen therefrom that, corresponding to the drop of 2·03 candles in illuminating power, the mixed gas supplied by the Gaslight and Coke Company has fallen by 10·3 calories gross, and 9·4 calories net per cubic foot in two years. On the other hand, the fall of 0·99 candle in the illuminating power of the South Metropolitan Company's coal gas has been attended by a drop of only 4·7 calories gross and 3·7 calories net. The fall in calorific power corresponding with a drop of one candle in illuminating power therefore appears to be rather greater with the mixed gas than with the coal gas. The maximum results of the calorific power testings do not call for comment; but the minimum results are of importance, since the Gaslight and Coke Company are now bound to supply gas which does not fall below 112½ calories net per cubic foot on the average of three consecutive days' testings or below 106½ calories on a single day. It will be seen that the gas of all the Companies has been maintained throughout the quarter well above these prescribed minima; the lowest figure—that for the Gaslight and Coke Company—being 112·9 calories net per cubic foot.

Sulphur.

A summary of the results of the testings for the amount of sulphur contained in the gas supplied is given in Table III. There has been no marked change in the proportion of sulphur contained in the gas of either the Gaslight and Coke Company or the Commercial Company in the last quarter of 1910 as compared with the corresponding quarters of 1908 and 1909; but the average amount of sulphur in the gas of the South Metropolitan Gas Company has fallen from 47·2 grains per 100 cubic feet in the fourth quarter of 1908 to 28·8 grains in the quarter just ended. The maximum in the same quarter of 1908 was 98·7 grains, but in the last quarter of 1910 only 58·0 grains. Having regard to the fact that the Company supply only coal gas, it is evident that simple oxide purification is no longer solely practised by it.

Results for Complete Years.

The figures relate to the 52 weeks ended Dec. 31, 1910; and those given for comparison for the two preceding years are: As to 1908, for 52 weeks ended Dec. 28; and as to 1909, for 53 weeks ended Jan. 1, 1910.

Illuminating Power.

The average results for each complete year of the testings of illuminating power are shown in Table IV. In two years the average illuminating power of the gas supplied by the Gaslight and Coke Company has fallen by 1·71 candles, while the statutory requirement has fallen by 2 candles. Naturally, however, the Company have not been able at once to take full advantage of the reduction in the prescribed illuminating power of the gas which they supply; but the results for the last quarter of the year, quoted in Table I., indicate that they are now working more closely to the 14-candle standard. Corresponding with the reduction of 1·71 candles in the average illuminating power as tested by the No. 2 "Metropolitan" argand burner, there is a reduction of 3·1 candles in the illuminating value of the flat-flame. But it should be remembered, in comparing these figures and similar figures for the fourth quarter of each year, that the flat-flame and argand testings of this Company's gas are no longer made on the same day—the argand tests only being made on weekdays, and the flat-flame tests only on Sundays. [See the "Journal," Vol. CVIII., p. 266.] Hence no relation can be certainly established from the figures published by the London County Council between the two sets of testings for illuminating power for this Company's gas after the end of the year 1909. In the case of the other two Companies, testings with the two burners are usually made at about the same time on each day. The illuminating power of the gas supplied by the South Metropolitan Company has fallen by 0·71 candle in two years, but is still much above the prescribed standard of 14 candles. Corresponding with the drop of 0·71 candle in the average illuminating power as tested with the standard argand, there is a drop of 1·1 candle in the average flat-flame value. There is a falling off of 0·39 candle in the average illuminating power of the gas supplied by the Commercial Gas Company; and this has been attended by a drop of 0·74 candle in the average flat-flame value. It is worth while observing that the Commercial Gas Company have succeeded during the last two years in working much more closely to the prescribed standard of 14-candle power than either of the other Metropolitan Companies,

Table I.—*Average of all the Testings of Illuminating Power for the Fourth Quarter of the Year* [*Candles*].

Burner	No. 2 Metropolitan Argand.			Flat-Flame.		
Year	1908.	1909.	1910.	1908.	1909.	1910.
Gaslight and Coke Company	16·96	15·82	14·93	12·00	10·10	8·56
South Metropolitan Gas Company	16·71	16·12	15·72	11·32	10·38	9·91
Commercial Gas Company	14·85	14·57	14·81	8·90	8·75	8·78

Table II.—*Summary of Testings of Calorific Power for the Fourth Quarter of the Year* [*Calories per Cubic Foot*].

Company.	Average.			Maximum.			Minimum.		
	1908.	1909.	1910.	1908.	1909.	1910.	1908.	1909.	1910.
Gaslight and Coke—									
*Gross	147·9	140·9	137·6	176·1	151·6	148·5	137·6	129·9†	127·5
Net	132·0	125·5	122·6	158·4	139·6	132·0	118·3	116·0†	112·9
South Metropolitan—									
*Gross	150·8	148·7	146·1	159·6	170·3	156·3	144·5	137·7	135·0
Net	133·9	132·1	130·2	151·3	152·7	139·4	127·2	122·0	120·3
Commercial—									
*Gross	139·2	140·4	140·0	149·7	151·7	152·9	131·6	132·3	127·5
Net	124·1	125·0	124·7	135·4	133·9	136·6	116·7	116·2	114·0

* The gross calorific power was not reported for the first five weeks of the fourth quarter of 1908, and the figures given refer to the last eight weeks only.

† The minimum calorific power at one testing-place for the Gaslight and Coke Company for the week ending Dec. 11, 1909, was omitted, and may have been lower than 116·0 calories net.

Table III.—*Summary of Testings of Sulphur in London Gas for the Fourth Quarter of the Year* [*Grains per 100 Cubic Feet*].

Company.	Average.			Maximum.		
	1908.	1909.	1910.	1908.	1909.	1910.
Gaslight and Coke Company	36·3	33·4	34·0	52·2	58·7	53·5
South Metropolitan Gas Company	47·2	38·6	28·8	98·7	75·7	58·0
Commercial Gas Company	30·4	30·6	26·9	47·3	49·9	46·0

Table IV.—*Average of all the Testings of Illuminating Power for the Whole Year* [*Candles*].

Burner	No. 2 Metropolitan Argand.			Flat-Flame.		
Year	1908.	1909.	1910.	1908.	1909.	1910.
Gaslight and Coke Company	16·93	16·52	15·22	12·14	11·30	9·04
South Metropolitan Gas Company	16·57	16·34	15·86	11·25	10·70	10·15
Commercial Gas Company	15·11	14·75	14·72	9·42	8·96	8·68

Table V.—*Summary of Testings of Calorific Power for the Whole Year* [*Calories per Cubic Foot*].

Company.	Average.			Maximum.			Minimum.		
	1908.	1909.	1910.	1908.	1909.	1910.	1908.	1909.	1910.
Gaslight and Coke—									
*Gross	—	144·3	138·0	—	162·0	154·8	—	129·9†	126·6
Net	131·7	128·8	122·9	158·4	144·6	139·4	118·3	116·0†	112·6
South Metropolitan—									
*Gross	—	148·9	146·6	—	170·3	158·0	—	130·3	135·0
Net	133·6	132·1	131·1	151·3	152·7	140·9	121·6	117·3	120·1
Commercial—									
*Gross	—	140·8	138·4	—	151·7	159·4	—	130 0	118·3
Net	126·5	125·6	123·4	139·2	136·5	143·0	114·6	115·2	106·1

* The gross calorific power was not reported for the whole year 1908, but only for the last eight weeks.

† The minimum calorific power at one testing-place for the Gaslight and Coke Company for the week ending Dec. 11, 1909, was omitted, and may have been lower than 116·0 calories net.

Table VI.—*Summary of Testings of Sulphur in London Gas for the Whole Year* [*Grains per 100 Cubic Feet*].

Company.	Average.			Maximum.		
	1908.	1909.	1910.	1908.	1909.	1910.
Gaslight and Coke Company	40·7	35·4	35·3	74·9	58·8	71·9
South Metropolitan Company	48·1	43·1	32·0	98·7	107·3	70·7
Commercial Gas Company	28·5	34·0	28·0	57·2	72·2	52·7

Table VII.—*Maximum and Minimum Results of the Testings of Pressure in 1910* [*Tenths of an Inch*].

Company.	No. of Testings in the Year.	Highest Pressure Observed.	Lowest Pressure Observed.
Gaslight and Coke Company	37	45	30
South Metropolitan Gas Company	18	40	19
Commercial Gas Company	5	40	30

though they have even yet a margin of something like ¾ candle in hand, besides the "grace" of ½ candle which the Acts allow before any forfeiture is incurred for deficiency of illuminating power. The results for the last quarter, quoted in Table I., however, show that the Gaslight and Coke Company are now approaching to the same working standard of illuminating power as that to which the Commercial Gas Company have worked for the last two years. The minimum returns of illuminating power for the year occurred, so far as the Gaslight and Coke and the Commercial Companies are concerned, in the fourth quarter, and have already been referred to. In both the first and second quarters, however, the South Metropolitan Gas Company had minimum returns of 14 candles, which are the lowest for that Company for the year.

Calorific Power.

The results of the testings of calorific power in 1910 and the two preceding years are summarized in Table V. It will be seen that, corresponding with the drop of 1·71 candles in illuminating power during two years, there has been a fall in the average net calorific power of the gas supplied by the Gaslight and Coke Company of 8·8 calories per cubic foot. The gas supplied by the Commercial Company, which is likewise a mixture of coal gas and water gas, has fallen in its average net calorific power in two years by 3·1 calories per cubic foot, in correspondence with the fall of 0·39 candle in illuminating power. The diminution of 0·71 candle in the average illuminating power of the coal gas supplied by the South Metropolitan Gas Company has been accompanied by a decrease of 2·5 calories in the average net calorific power. The minimum values recorded for the net calorific power last year have been 112·6 calories per cubic foot for the Gaslight and Coke Company, 120·1 for the South Metropolitan Company, and 106·1 for the Commercial Company. The last-named figure is below the "catch-penalty" limit of 106½ calories prescribed for the Gaslight and Coke Company in their Act of 1909. Fortunately, the Commercial Company are not required by Statute to work to the standard of calorific power at present prescribed for the Gaslight and Coke Company.

The minimum return of calorific power was obtained in the quarter of the year in which the minimum return of illuminating power for the same Company's gas was 14·04 candles. The Companies are not liable to incur a forfeiture in respect of illuminating power unless it falls below 13·5 candles; so that, with a margin in hand of 0·54 candle in respect of illuminating power, the Commercial Gas Company would, if they had been working under the statutory provisions of the Gaslight and Coke Company in regard to calorific power, have been penalized for deficiency of calorific power, while observing with ample margin their obligations as to illuminating power. It is therefore clear that the standard of calorific power at present prescribed for the Gaslight and Coke Company is higher than corresponds with the prescribed standard of illuminating power for the three Companies.

Sulphur.

The average amounts of sulphur found in the gas supplied by the three Companies for the whole of the year 1910 and the two preceding years are shown in Table VI. The Gaslight and Coke Company have reduced the average amount of sulphur in their gas by about 5 grains per 100 cubic feet in two years; but the most remarkable feature of the table is the substantial reduction of 16 grains effected by the South Metropolitan Company. The inference in regard to the purification of this Company's gas which has already been made in the comments on the testings for the fourth quarter of last year is confirmed by the comparative results for the complete years 1908-1910. The maximum returns of sulphur in the gas are also generally lower last year than two years ago.

Pressure.

The testings of pressure are made at irregular intervals at street-lamp standards. The time and place when these testings are made rest entirely with the London County Council. By the Acts, the Companies are required to maintain the pressure of the gas from sunset to midnight to be such as to balance a column of water not less than one inch in height, and from midnight to sunset not less than 6-10ths of an inch in height. The results for the year 1910 are summarized in Table VII., from which it will be seen that in no instance did the pressure observed fall nearly so low as the prescribed minima.

Manchester University Lectures.—The fifth lecture of the series will be delivered next Saturday by Mr. J. T. Sheard, the Chief Chemist to the Sheffield United Gas Company; his subject being "Chemical Control of Gas-Works." The chair will be taken by the Mayor of Salford (Alderman F. S. Phillips).

The 48-Inch Gas-Main under the Harlem River.—In the last number of the "Journal" (p. 221), we gave the paper describing the work of laying three large gas-mains under the Harlem River by the Consolidated Gas Company of New York, contributed to the last meeting of the American Gas Institute by Mr. Colin C. Simpson, who had the direct engineering supervision of the work. We learn from the "American Gaslight Journal" that the laying of the largest main (the 48-inch) has been satisfactorily completed without a single serious accident. It ensures an additional supply of gas up to a million cubic feet per day to the Bronx district.

THE INVENTION, DEVELOPMENT, AND PRESENT POSITION OF THE DESSAU VERTICAL RETORT.

[Communicated.]

II.

The previous article of this series [*ante*, p. 150] dealt with the evolution of the vertical retort at Dessau, and the general effects of the altered conditions of carbonization on the quantity and nature of the products obtained. It is now intended to quote representative results from published reports of the working of a few typical installations of Dessau vertical retorts. So many results have been quoted from time to time in the columns of the "Journal," that the object now is only to bring together those which appear to have some special claim to attention, either by reason of their marking definite stages in the development of the Dessau system, or by reason of their having been checked and authenticated more carefully than usual, or by reason of the coal used and the conditions of working having been closely akin to those to which English gas engineers are accustomed. Unless otherwise stated, the make of gas will have been corrected to English standard conditions of measurement—viz., 60° Fahr., 30 inches, and saturated with water vapour; and the calorific power and illuminating power, wherever stated, will refer similarly to cubic feet measured under the same standard conditions. It is necessary to mention this, because the Dessau vertical retorts have sometimes been credited with yielding a lower make of gas than was correct, owing to the common Continental practice of correcting the make of gas to a corresponding volume at 32° Fahr., 29·9 inches, and dry.

The First Dessau Results.

Dr. Bueb reported to a gathering of gas engineers and technical men on Sept. 20, 1905 [*vide* Journal, Vol. XCI., p. 807] the results of the continuous working for some months of two settings, each containing ten vertical retorts 4 metres (13 ft. 1 in.) long. These early working results are valuable mainly on account of their historical interest, and will be quoted only briefly. The charge of coal per retort amounted to 10 to 11 cwt., and the time of working off the charge ranged from 8 to 10 hours, according to the description of coal used. A larger number of varieties of coal were carbonized experimentally in these settings. In addition to well-known Westphalian coals, trials were made, among English coals, of New Leverson, Leverson-Wallsend, New Pelton, Pelton Main, Boldon, and Hebburn Main. Separate results do not appear to have been recorded for each variety of coal; the object of varying the coal being chiefly to ascertain whether the vertical retort behaved properly with coals of widely different character so far as thorough working off of the charge and easy discharge of the block of coke were concerned. Hence the yield of gas was not recorded separately for each description of coal. The average make of gas given by Dr. Bueb for each of three months during which the settings had been in regular work, therefore referred to the mean result obtained from a large number of varieties of English, Westphalian, and other coals. The only coal with which any difficulty at all was found in working was an Upper Silesian gas coal, which, it is well-known, almost liquefies in the early stages of carbonization. During the first two months for which the results were reported, the settings were not continuously at full work, because they were required to take up fluctuations in the consumption of gas in the town. For the last month—viz., August—they were in full work, and the make of gas averaged 31·661 cubic metres at 15° C., 760 mm., saturated, per 100 kilos of coal, or 11,360 cubic feet per ton. The calorific power of the gas made varied between 573 and 607 B.Th.U. gross per cubic foot. The illuminating power was 12·98 hefners when the gas was consumed at the rate of 150 litres (5·3 cubic feet) per hour in a batswing burner. This is equivalent to about 11·02 candles for the 5 cubic feet rate in a flat-flame burner, which, it is known from general comparisons of the illuminating power of coal gas in the flat-flame and the standard No. 2 Metropolitan burner, is equivalent to an illuminating power of about 16·35 candles according to the present English standard method of testing gas.

The yield of coke was about the same as with horizontal retorts—viz., with Westphalian coal about 71 per cent. by weight of coal carbonized. The coke, however, was denser, harder, and in larger pieces than that obtained from horizontal or inclined retorts. The consumption of coke as fuel for heating the experimental settings was, with coal containing a normal proportion of 6 to 8 per cent. of ash, equivalent to 14 per cent. of the weight of coal carbonized. The yield of ammonia was considerably greater than with horizontal retorts, and amounted, with Westphalian coal, to 0·373 per cent. (real ammonia) of the weight of coal carbonized, which is equivalent to a return of about 32½ lbs. of sulphate per ton of coal. On the other hand, there was a reduction of about 40 per cent. in the yield of cyanogen. The amount of tar produced was somewhat higher than with horizontal settings, and its quality was very different from, and superior to, that obtained from the latter. The vertical-retort tar contained only 2 to 4 per cent. of free carbon in place of upwards of 20 per cent. in other coal tar; and its specific gravity was about 1·1, against 1·2 for other tar. An analysis of the tar obtained from New Leverson and Leverson-Wallsend coals in the vertical retorts showed that the tar oils formed 46·08 per cent., and the

pitch 49·75 per cent. of the tar; whereas the tar from the same coals carbonized in horizontal retorts contained only 32·47 per cent. of tar oils and 62 per cent. of pitch. The napthalene in the vertical-retort tar was about 50 per cent. less than in the horizontal-retort tar; and a similar difference was found in the proportion of naphthalene in the gas produced. The labour required for the working of these two experimental settings was much less than for horizontal settings of the same productive capacity; but the details are not now of interest, because later data relating to installations on a larger working scale are now available.

The particulars given by Dr. Bueb as to the temperatures prevailing in the experimental settings are, however, of considerable interest. The temperature in the setting ranged from 1300° to 1400° C. (2372° to 2552° Fahr.). Table I. shows the temperatures in the innermost core of the charge, and the temperature of the gas as it escaped from the retort at different times after charging.

TABLE I.—*Temperature Changes during Carbonization of a Charge.*

Time after Charging.	Temperature in Core of Charge.		Temperature of Escaping Gas.	
	Degrees. Cent.	Degrees. Fahr.	Degrees. Cent.	Degrees. Fahr.
½ hour	90	194	..	..
¼ ,,	105	221	..	..
1 ,,	145	293	190	374
2 hours	200	392	310	590
3 ,,	280	536	315	599
4 ,,	370	698	318	604
5 ,,	440	824	217	426
6 ,,	470	878	215	419
7 ,,	500	932	213	415
8 ,,	580	1076	210	410
9 ,,	620	1148	205	401
10 ,,	..	..	188	370

It will be seen from these figures that, notwithstanding the exceptionally high heat of the setting, superheating of the gas had been avoided, and that, until near the close of the time of distillation, a relatively cool core remained in the charge, to serve as an exit passage for the gas and tar produced. This was quite consistent with the observed result of an increased yield of ammonia and a greatly decreased formation of naphthalene; since ammonia is decomposed by exposure to a high temperature, and naphthalene is a product of the decomposition of simpler hydrocarbons at a high temperature.

Further Results from Dessau.

Dr. Bueb, in a paper which he read at Bremen on June 28, 1906 [*vide* "JOURNAL," Vol. XCV., p. 23], gave particulars of the further working of the two experimental settings of vertical retorts at the Dessau Gas-Works, of which the first three months' working results have been referred to in the foregoing. This second communication is interesting, because it shows that not only had the good results previously obtained been maintained in continuous work, but that they had been greatly surpassed. Also it had been found by trial that a far greater yield of gas could be obtained from the charge of coal if steam were passed in a continuous stream into the lower part of the retort after carbonization had all but completed itself. It was proved that, if gas of high illuminating power were not required, a considerable increase in the make of gas, without large depreciation of the calorific power, could be secured by means of steaming. Dr. Bueb, on this occasion, reported the results of a number of scientific investigations which had been made on four of the retorts which had been isolated from the rest to serve as a special experimental plant. With these retorts, the yield per hour of gas, ammonia, and cyanogen, and the illuminating power and calorific value of the gas made, had been determined in order to obtain a continuous record of the course of carbonization in the vertical retorts. One of the coals on which experiments had been made was New Leverson; and some particulars may be given of these results.

The quantity of coal carbonized at one charging in the four retorts was 2 metric tons (1·968 English tons). The charge was worked off in 12 hours; and the make of gas per ton of coal, without introduction of steam to the retort, was 11,518 cubic feet, and its illuminating power 13 hefners when consumed in a flat-flame burner at the rate of 150 litres (5·3 cubic feet) per hour, which is equivalent to 11·05 English candles per 5 cubic feet. From general knowledge of the relation between the illuminating power in a good flat-flame burner and in the standard No. 2 Metropolitan argand burner, it may be inferred that the illuminating power of this gas averaged 16·40 candles in English standard conditions. The average gross calorific power of the gas made was 589 B.Th.U. per cubic foot. The average yield of ammonia was equal to 0·318 per cent. (real ammonia) of the weight of coal carbonized, which is equivalent to a production of about 27¾ lbs. of sulphate per ton of coal. The yield of cyanogen was equivalent to 0·49 part of yellow prussiate of potash per 100 parts of coal carbonized, or to 11 lbs. of yellow prussiate per ton of coal. The average specific gravity of the gas was ·41. The make of gas and its illuminating power and calorific value were highest in the first hour of distillation, and gradually fell off to the twelfth hour. The production of ammonia was highest at about the third hour, and after the fifth hour fell off fairly rapidly. On the other hand, the production of cyanogen was highest in the sixth and seventh hours, and was tolerably uniform until the last two or three hours, when it fell off rapidly.

These investigations were of interest chiefly as showing the changes which take place as carbonization of the coal proceeds in the vertical retort. The make was, however, lower than that obtained in continuous working on the large scale. The latter make was stated by Dr. Bueb to be with normal gas coal at least 35 cubic metres per 100 kilos, which is equal to 12,560 cubic feet per ton; and the gross calorific power of the gas produced was not less than 524 B.Th.U. per cubic foot. This deduction as to the make of gas obtainable per ton of normal gas coal in vertical retorts in June, 1906, was drawn from the general experience gained with the experimental settings at Dessau, and with settings of longer vertical retorts at the Mariendorf works in Berlin.

It will be convenient next to refer in greater detail to results obtained in the latter settings, which were reported upon by Mr. E. Körting, the General Manager in Berlin of the Imperial Continental Gas Association.

The First Mariendorf Results.

The first installation of Dessau vertical retorts at the Mariendorf (Berlin) Works of the Imperial Continental Gas Association has already been referred to. It consisted of a setting of twelve vertical retorts, 5 metres (16 ft. 5 in.) in length. The experiences gained in the working of this setting for a period of over two months were recorded by Mr. Körting in a report which he made in January, 1906 [*vide* "JOURNAL," Vol. XCIII., p. 342, and Vol. XCIV., p. 25]. This report gave measurements of the temperature at different depths in the furnace which have been quoted in the first of this series of articles. During the greater part of the trial period, English coal was carbonized; one variety being of a normal character, and the other a poor gas-making coal. The results obtained with the first of these two English coals were, with a charge of 12·58 cwt. per retort and a carbonizing time of 11 hours 10 minutes, that the make of gas was 11,805 cubic feet per ton of coal; the gross calorific power of the gas being 610 B.Th.U. per cubic foot. The illuminating power of the gas from this coal was not definitely reported at the time; but in a subsequent discussion on the subject, Mr. Körting stated that measurements of the illuminating power of the vertical-retort gas generally at that time gave it a value of about 15 candles per 5 cubic feet per hour consumed in the No. 1 London argand burner. This may be taken as equivalent to an illuminating power of about 17 candles with the standard No. 2 Metropolitan burner [*vide infra*]. The yield of tar from the various coals (mostly English) carbonized at Mariendorf averaged 4·2 per cent. by weight of the coal; while the yield of ammonia was equal to 0·334 per cent. real ammonia, or 29 lbs. of sulphate per ton of coal carbonized. Mr. Körting pointed out that this compared with an average yield of sulphate of 19½ lbs. per ton of coal for the working of the Mariendorf inclined retort settings throughout the year 1905. The tar was of considerably better quality than that from the inclined retorts. It contained 60·2 per cent. of oils and 34·1 per cent. of pitch, as compared with 39·2 per cent. of oils and 58·1 per cent. of pitch in the tar from the inclined retorts. The coke was of uniformly good quality, and less dependent on the character of the coal than that from inclined and horizontal retorts. Comparing the calorific power of the vertical-retort gas with that of the gas made in horizontal and inclined retorts at other works of the Imperial Continental Gas Association in Berlin, it was found that the inclined-retort gas was 2·4 per cent. better than the horizontal, and the vertical-retort gas 5·9 per cent. better. Similar figures published in respect of the relative illuminating power of the gas made in the different types of retort were of less significance, since they demonstrated mainly the futility of using any other burner than the No. 2 Metropolitan argand for comparing the illuminating power of gases of widely different qualities. The illuminating power of the Mariendorf vertical-retort gas was stated in these comparative figures to be 12·3 candles; and presuming this refers to a test made at the rate of 150 litres (5·3 cubic feet per hour) in a flat-flame burner, it would be equivalent to an illuminating power in standard English conditions with the No. 2 Metropolitan argand burner of 16·85 candles (*cf. supra*).

Some further information as to the behaviour of the Mariendorf retort-settings was given in a paper which Mr. Körting read on March 11, 1906, in which he compared continuous carbonization, as carried out in the Woodall-Duckham vertical retort, and carbonization with intermittent charging, as practised in the Dessau retort ["JOURNAL," Vol. XCIV., p. 97]. He pointed out that the Mariendorf setting of Dessau retorts was more or less an experimental departure of his own, in that the retorts were 1 metre longer than those which had been successfully operated previously at Dessau. At first, a little difficulty had been experienced in heating adequately the upper parts of these long retorts, and some reconstruction of the setting had, therefore, to be carried out. Experiments had been made in the reconstructed setting on the introduction of steam into the vertical retorts, and its effect in increasing the make of gas and reducing or abolishing the deposition of scurf in the retort. It was not, however, till a later date that the detailed results of the working of Dessau vertical retorts with steaming were published. The only information given about that time was in the paper which Mr. Körting read before the Institution of Gas Engineers on June 19, 1906 ["JOURNAL," Vol. XCIV., p. 878]. It was there stated that Boldon (Durham) coal carbonized without steaming in a fortnight's trial in the Dessau retorts at Mariendorf gave a make of 11,700 cubic feet of gas per

ton, having a calorific power of 614 B.Th.U. per cubic foot, and an illuminating power of 13·5 candles—presumably tested with the No. 1 London argand burner, and therefore equivalent to about 16 candles with the No. 2 Metropolitan argand. On the other hand, when steam was admitted to the retorts, the make of gas was increased to 13,250 cubic feet per ton, and the calorific power of the gas was 579 B.Th.U. per cubic foot. The illuminating power, however, had fallen to 11 candles, which may be taken as approximately equal to 14 candles with the No. 2 Metropolitan argand burner. In summing up his conclusions on carbonization in vertical retorts, Mr. Körting said that it might be accepted that, with steaming, one ton of good Durham coal yielded in Dessau retorts 13,500 cubic feet of gas, having an average calorific power of 560 B.Th.U. At Berlin, the horizontal retorts at high heats were at that time giving a make of 11,000 cubic feet per ton; the calorific value being about 567 B.Th.U. per cubic foot.

Deductions from Working of Experimental Settings.

The results obtained in the exhaustive trials of the experimental settings of vertical retorts at the Dessau and Mariendorf Gas-Works have now been quoted; and it will be appropriate, before passing on to a consideration of subsequent results on a large working scale, to indicate the position of the Dessau system at the close of the year 1906. At that date, the two experimental installations named had been in use for over a year. The one installation was of 4-metre, and the other of 5-metre, retorts. In brief, the results of the working of the installations demonstrated that, without steaming, a make of gas averaging about 11,800 cubic feet per ton of coal was obtained from Durham coal, which when carbonized in horizontal or inclined retorts gave a make about 10 per cent. lower than this figure. The illuminating power of this vertical-retort gas, if tested under English standard conditions, would have averaged 16¼ candles. Its calorific power averaged 600 B.Th.U., or over 150 calories, per cubic foot. This refers to the gross calorific power, which alone is taken into consideration on the Continent. But as, provisionally, a standard of calorific power based on the so-called net value has been adopted for the gas supplied in London by the Gaslight and Coke Company, it may be worth while stating that the aforesaid calorific power of the vertical-retort gas is equivalent to about 135 calories (or 540 B.Th.U.) net per cubic foot. The Gaslight and Coke Company are not liable to incur any forfeiture provided the net calorific power of their gas does not, on the average of three days' testings, fall below 112½ calories per cubic foot. It is, perhaps, more pertinent, however, to compare the calorific power of Dessau vertical-retort gas made without steaming with that of the coal gas unmixed with water gas which the South Metropolitan Gas Company supply in London. The gross calorific power of the latter gas in the two years 1909 and 1910 has averaged 147·7 calories (say, 590 B.Th.U.) per cubic foot, which is 3½ calories, or about 14 B.Th.U., below the calorific power of the vertical-retort gas. Thus it is evident that in respect both of illuminating power and calorific power, the vertical-retort gas had been proved in 1906 to be far in advance of the most stringent interpretation of the requirements in regard to the gas supply in London.

Passing on from the gas to the bye-products, we find that the average yield of ammonia was equal to very nearly 30 lbs. of sulphate per ton of coal carbonized. The yield of tar was somewhat greater than with horizontal retorts; but there was a very marked difference in its character, since on distillation it yielded on the average about 53 per cent. of oils and about 42 per cent. of pitch, which compares with about 70 per cent. of pitch in tar from Durham coal as carbonized in England at high heats in horizontal or inclined retorts. The pitch was, however, relatively free from uncombined carbon; the proportion of free carbon in the vertical-retort tar being only 2 to 4 per cent., while in ordinary coal tar made at high heats it would be 18 per cent. or more. The quantity of naphthalene in the vertical-retort gas was so small as to be almost negligible. According to one report, it may have amounted to as much as 50 per cent. of the quantity present in the gas from horizontal retorts. All the reports agree in stating that the vertical-retort coke was of much superior quality to the horizontal-retort coke from similar coal, and that, being less friable, it produced less breeze in handling. Throughout the working of the experimental settings to this date, there was no evidence of any appreciable depreciation of the retorts, which even then promised to have a life as long as, or longer than, horizontal retorts, notwithstanding the high temperature at which they were worked. Also there was unanimity in the reports as to the ease of charging and discharging of the vertical retorts, and as to the absolute freedom from stoppages in the gas exit pipes and from thick tar in the hydraulic main. Hence it may be taken as having been fairly substantiated that the Dessau system of vertical retorts, as compared with other systems of carbonization in operation at that date, afforded a make of gas higher by about 10 per cent., with no diminution, but rather an improvement, in the quality of the gas; an increase of about 50 per cent. in the yield of ammonia; a thinner and more valuable tar; virtual freedom from naphthalene, and absolute freedom from blockages of exit pipes and hydraulic mains; a better coke; and, as will be demonstrated fully by reference to the large-scale working, a saving of labour and of ground space.

Finally, the practicability of greatly increasing the make of gas per ton of coal by introducing steam into the retorts had been shown by actual trials. Thus with average Durham coal a make of 13,400 cubic feet of gas per ton was found to be possible; while the average calorific power of the gas would be maintained at 545 B.Th.U. per cubic foot, and the illuminating power at about 14 candles. This gas corresponds closely in quality with that supplied at the present time in London (north of the Thames), and is considerably superior to the quality which the Gaslight and Coke Company are called upon under their statutory obligations to supply.

Table II.—*Chief Installations Erected or Ordered in* 1906.

Retorts in all installations 4 metres (13 ft. 1 in.) in length, except those at the two Berlin works, which were 5 metres (16 ft. 5 in.) in length.

Works.	Number of Settings.	Number of Retorts in Setting.	Total Number of Retorts.
Barcelona	15	10	150
Berlin—			
Mariendorf	7	12	84
Oberspree	5	12	60
Brandenburg	6	10	60
Cologne	24	10	240
Dessau	4	10	40
Dortmund	10	10	100
Duisberg	5	10	50
Potsdam	4	10	40
Zürich	10	10	100
		Total	924

In the next article, the working results obtained in some of the installations referred to in Table II. will be given.

(*To be continued.*)

SOME SUGGESTIONS FOR THE EXTENSION OF BYE-PRODUCT TREATMENT ON GAS-WORKS.

By G. Stanley Cooper, B.Sc.

The development of the gas industry now-a-days is not to be looked for entirely in the direction of increased gas yields per ton of coal carbonized, but perhaps rather in that of improved treatment of the residuals and bye-products. The manufacture of coal gas is becoming more and more to be applications of pure scientific principles; and since the process of combustion came to be regarded as a distinct chemical operation, and has been studied as such, all carbonization methods have been improving by leaps and bounds.

We are continually hearing of "light and heavy charges," "carbonization temperatures," &c., as being influential factors on the quality and quantity of the gas produced and the nature and quantities of the impurities. In most commercial processes, impurities generally mean waste products, and no contribution to revenue. This is by no means the case in the gas industry; for, taking random figures from a gas company's half-yearly account, we see: Total receipts from sale of gas, £200,029 12s. 6d.; receipts from bye-products, £46,300 16s. 11d.—the total coal and oil bill (including carriage, &c.) for the same period being £91,320 13s. 11d. Thus about 50 per cent. of the coal bill is paid for out of the revenue from bye-products, most of which are made from impurities in the gas. It becomes a very important point, therefore, and one well worth consideration, to inquire if the most is being made of the treatment of residuals, and, if not, to attempt to find out where improvements can be effected.

The treatment of all bye-products and their conversion into useful and saleable commercial commodities is essentially a matter for the chemist, as these changes are to be brought about chiefly by chemical reactions involving double decompositions, or by processes of distillation and further disintegration. Thus, sulphate of ammonia is produced by the interaction of ammonia gas and sulphuric acid; while benzene, toluene, phenol, cresol, &c., are all produced by the fractional distillation of tar.

Since sulphate of ammonia is made on most gas-works carrying out any treatment of their own bye-products, sulphuric acid is a very important and necessary substance. It might be useful, therefore, to suggest other processes which could be carried out on the gas-works involving the use of sulphuric acid and some bye-product of coal-gas manufacture other than ammonia. First of all, however, it will be as well to consider the possibility of the manufacture of sulphuric acid in connection with the gas-works concern. If this substance were produced on, or by, the works, a great saving would thereby be effected; and this is by no means impossible. I believe I am correct in stating that at Bradford, where the Corporation own the gas-works, there is also a municipal chemical works, where sulphuric acid is made on a large scale. The ammoniacal liquor is conveyed in underground mains from the gas-works to the chemical works, and there converted into sulphate of ammonia in the usual way. What is possible in Bradford is possible elsewhere.

Sulphuric acid is made by the combination of sulphur dioxide and oxygen in the presence of steam, thus—$SO_2 + O + H_2O = H_2SO_4$. Special means have to be adopted to bring about the combination (as ordinarily the two gases do not react); and two processes are used for this. In the older process, the SO_2 is mixed with air—which, of course, supplies the oxygen—and nitric acid

vapour or nitrogen peroxide. The nitrogen peroxide with SO_2 forms SO_3, thus—$NO_2 + SO_2 = SO_3 + NO$. Nitric oxide, NO, so formed reacts with the oxygen of the air, and reforms NO_2; while the SO_3 combines with the steam to form liquid H_2SO_4.

In the newer, or contact, process, the mixture of SO_2 and oxygen is passed over heated platinized clay, when they combine with formation of SO_3. The SO_3 is absorbed in 98 per cent. H_2SO_4, the strength of which is maintained by running in a slow stream of water. In both processes, sulphur dioxide is used—usually obtained by the burning of iron pyrites, or sulphide of iron, FeS, in air; the sulphur combining with oxygen so as to form SO_2, while the iron forms ferric oxide, Fe_2O_3—thus: $2\ FeS + 7\ O = Fe_2O_3 + 2\ SO_2$.

Here it is that the close connection with the gas-works comes in. Sulphur is produced abundantly in the destructive distillation of coal, and usually occurs in the product as sulphuretted hydrogen, H_2S, or carbon bisulphide, CS_2. The first of these is removed by passing the gas through oxide purifiers, which contain hydrated ferric oxide, Fe_2O_3. The H_2S reacts on the oxide, thus—$Fe_2O_3 + 3\ H_2S = 2\ FeS + 3\ H_2O + S$. The fouled oxide is cleaned by exposure to the air, when re-oxidation takes place, and more sulphur is deposited—$2\ FeS + 3\ O = Fe_2O_3 + 2\ S$.

After having been used several times, therefore, the spent oxide consists largely of FeS and free sulphur. Both these substances, on burning, yield sulphur dioxide; the FeS being similar in composition (broadly) to the iron pyrites referred to above. By burning the spent oxide as a whole, the free sulphur is removed as SO_2, and the FeS is converted into Fe_2O_3, ferric oxide, which substance is the one used in the oxide purifiers. It cannot be directly used for this purpose, however, as the temperature necessary to burn the spent oxide brings about dehydration of the oxide itself, and renders it partially incapable of reaction with H_2S. It should not be a difficult matter to get over this objection. There remains also another alternative; and that is to remove the free sulphur from the spent oxide by solution. Various reagents have been suggested for this purpose—such as carbon bisulphide, ammonia, ammonium sulphide, petroleum, tetra-chlorethane, ortho-dichlorobenzol, &c., all of which are capable of dissolving fairly large amounts of sulphur. By evaporation of the resulting solutions, free sulphur would be obtained, and could be burnt alone. It will be seen, therefore, that the manufacture of sulphuric acid is very closely connected with the gas industry; and it is not unlikely that it will be taken up more generally in the near future.

With regard to the treatment of bye-products with sulphuric acid, the possibilities are almost unlimited. Naphthalene is produced in large quantities on all gas-works, and by a little care can be obtained in a fairly pure state. This substance is used as the starting point of the manufacture of artificial indigo—the well-known blue dye. The naphthalene is heated with mercury and strong sulphuric acid, and this brings about atmospheric oxidation, with formation of phthalic anhydride. The action is represented by the following equation—

$$\underset{\text{Naphthalene}}{C_{10}H_8} + 9O = \underset{\text{Phthalic anhydride}}{C_6H_4(CO)_2O} + 2CO_2 + 2H_2O.$$

The phthalic anhydride obtained is then treated with ammonia under pressure, and is converted into phthalimide, $C_6H_4(CO)_2NH$, thus—

$$C_6H_4(CO)_2O + NH_3 = C_6H_4(CO)_2NH + H_2O.$$

Naphthalene and ammonia are both gas-works products, and so could be readily obtained. Thio-indigo is a substance closely allied to indigo, and, as its name implies, contains sulphur, which is another bye-product of the works.

Coal tar itself contains an abundance of products which can be made use of in many ways. A large quantity of the tar is distilled in an iron retort, when water passes over holding ammonia salts in solution, and accompanied by a brown, oily liquid, which collects on the surface of the water. This is the light oil containing the benzene hydrocarbons. To purify it, it is shaken with sulphuric acid, which removes aniline and other basic compounds, and afterwards with caustic soda, to dissolve carbolic acid and other phenols. This light oil is then submitted to a process of fractional distillation. Coal tar is a very complex mixture, the principal constituents of which are:

Liquids.	*Solids.*
Benzene, toluene, xylene,	Naphthalene, anthracene,
Aniline, quinoline, pyridine,	Phenols, pitch.

Anthracene can be used as the starting-point in the synthesis of alizarin blue—a process now carried out on a commercial scale. The anthracene is heated in leaden tanks with potassium dichromate and dilute sulphuric acid, and is thereby oxidized to anthraquinone. This is heated for some time with fuming sulphuric acid, and converted into anthraquinone sulphonic acids, which, by further treatment, are converted into alizarin.

Referring to the particulars published in the "JOURNAL" for the 3rd inst., as to the caulking of some large American mains with lead wool by pneumatic tools, a correspondent sends the figures of the hand caulking of a 60-inch main with lead wool. A considerable length of this size of main has been put in for one of the large English corporations; and two men caulked on an average four joints in 15¾ hours. The actual cost of labour to joint the pipes was 5s. 3d., which certainly speaks well for the English caulker.

GAS LEGISLATION FOR 1911.

[FIFTH ARTICLE.]

PROCEEDING with the review of the Provisional Orders with which the Board of Trade have been invited to deal in the session now close at hand, there are eight more to be noticed.

The first is that of the Longford District Gas Company. The limits of supply are defined as the urban district of Longford and several neighbouring townlands, in the parish of Templemichael. The capital of the Company, it is now proposed, shall not exceed £22,000. This will consist of the original capital of £12,000, a moiety of which has been issued as ordinary shares and the other as preference, and additional capital to the amount of £10,000, to be issued under the latest form of auction and tender clause. The limits of dividend named are 8 per cent. on the original ordinary shares, 6 per cent. on the original preference capital, 7 per cent. on the additional ordinary capital, and 6 per cent. on the additional preference capital. The borrowing power is to be the now customary one-third. Special purposes and reserve funds are provided for. Land, works, and other clauses are of common form. A standard price of 5s. 6d. per 1000 cubic feet is proposed; and the operation of the sliding-scale will be, in respect of penny changes of price, at the rate of 4s. per cent. on the original ordinary capital and 3s. 6d. per cent. on the additional ordinary capital. It is suggested that the prescribed illuminating power shall be 12 candles, tested by the "Metropolitan" No. 2 burner. A purchase clause appears in favour of the District Council, operative in any one of the next three sessions of Parliament. But in assessing the sum to be paid by the Council, the value of the concern is not to be deemed to be enhanced or reduced by reason of the making of the present Order. [*Parliamentary Agent: Mr. R. J. Sheehy.*]

In the Order promoted by the North Pembrokeshire Water and Gas Company, sanction is desired to the attaching of a preferential dividend not exceeding 5 per cent. to the balance, or part of the balance, of the unissued capital authorized to be raised by their Act of 1899, as amended by the Act of 1900, by the creation and issue of new preference shares. It is proposed that the prescribed illuminating power of the gas shall be 14 candles, as tested by the "Metropolitan" No. 2 burner. Protection is given against the inconvenient demands for gas of persons using suction-gas plant [see terms of clause in succeeding notice of Petersfield Order]; and stand-by clauses referring to both private gas plants and electricity supply are incorporated. The discounts clause, confining the allowance to 10 and 15 per cent., is proposed. [*Parliamentary Agents: Messrs. Baker and Co.*]

The Petersfield and Selsey Gas Company are wanting more capital powers; and in the Order they have introduced, the additional capital is put at not exceeding £10,000, which will raise the share capital authorization to £40,000. If empowered to raise the further capital, it will be issued under the modern form of auction and tender clause. In regard to dividend, the provisions of the Company's Act of 1901 will apply to the new capital. The right of borrowing will extend to the equivalent of one-third of the amounts of the issues. Provision for a special purposes fund is included. It is suggested that the prescribed illuminating power of the gas shall be 14 candles, tested by the "Metropolitan" No. 2 burner. Once again we renew acquaintance with the old 10 and 15 per cent. discounts clause, although the extension provided for by the Model Clauses of Section 13 of the Gas-Works Clauses Act of 1847 is made in the "Incorporation of Acts" clause. A protective clause in respect of premises having a suction-gas plant is included in the following terms:

> No penalty shall be incurred by the undertakers for neglect or refusal to give a supply of gas in accordance with the provisions of this Order to any company, body, or person who uses, or is in the habit of using, machinery or apparatus for making and utilizing suction gas, if and so long as, in the opinion of the undertakers, the giving of a supply by them to such company, body, or person would interfere with or jeopardize the supply of gas by the undertakers for public and private lighting and to consumers not using such machinery or apparatus as aforesaid.

A clause providing for a minimum payment for stand-by supplies in the case of consumers having private gas installations or having their premises supplied with electricity is proposed. There is also a clause to enact that the Company shall not be entitled to require the next tenant of premises vacated by a former consumer to pay any arrears, "unless the incoming tenant has undertaken with the former tenant to pay, or exonerate him from payment of, such arrears." [*Parliamentary Agents: Messrs. Baker and Co.*]

The Preston Gas Company are forward with an Order for the purpose of repealing, from Oct. 1 next, section 48 of their Act of 1894, which refers to the quality and testing of gas, and substituting therefor provisions arranging for a standard of 14 candles, as tested by the "Metropolitan" No. 2 burner. Then there is a clause providing for the amendment of section 45 of the Company's Act of 1865 by adding at the end "for illuminating purposes." This looks like the old—and, in the present day, unfair—public lighting provision. The special purposes fund clause, as well as the one providing for the carry-forward not exceeding an amount sufficient to pay a year's dividend on the preference and ordinary capital, appear among others of ordinary form. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

Wales is again to the fore through a further promotion of the Holyhead and North Wales Gas and Water Corporation, Limited,

who desire authorization to maintain and continue the existing gas-works and the manufacture and supply of gas in the borough of Pwllheli and parish of Denio in the county of Carnarvon, as well as other powers. It is intended that the capital shall consist of £6819 already expended (to be known as the original capital), and additional capital to the amount of £8181—making together £15,000. The new form of auction and tender clause will apply to the additional capital. The maximum dividends are to be 10 and 7 per cent. respectively on the original and additional ordinary capital, and 6 per cent. on any part of the latter issued as preference shares. The Company ask for borrowing powers to the amount of £6650. This exceeds the one-third limit. Succeeding the land and works clauses, the Company propose the now common prescription of 14-candle power as the illuminating standard, and the application of the "Metropolitan" No. 2 test-burner. The maximum charge for gas is suggested at 5s., with provision for subsequent revision or substitution of a standard price and sliding-scale. The prepayment clause asks for the right to charge 10d. extra when meter and fittings are supplied, but says nothing about the 1s. when a cooker is included. [*Parliamentary Agent: Mr. L. W. Byrne.*]

The Sheringham Gas and Water Company are desirous of obtaining powers to raise additional capital, and name £36,000—half to be allocated to the gas undertaking and half to the water undertaking, with a limit to preference stock of one-half in the case of both concerns. The modern form of auction and tender clause will apply to issues. Concerning borrowing powers, the promoters desire authority to borrow (together with the amounts already borrowed) one-third part of the total original and additional capital. [*Parliamentary Agent: Mr. R. A. Read.*]

In the main, the Order promoted by the Uxbridge Gas Company is for an extension of the area of supply to Chenies, Amersham, Penn, Little Missenden, Great Missenden, and part of the parish of Hughenden, all in Buckinghamshire, and Flaunden and Sarratt in Hertfordshire. A clause is inserted for the confirmation of the purchase of the property of the Amersham Gas Company (now in liquidation) upon the terms of an agreement dated July 29, 1910. Lands for gas manufacturing and storage purposes are scheduled. Authority is also to be taken to apply any capital raised under the powers of the Company's existing Acts for any of the purposes of the Order to which capital is properly applicable, and to the payment of £5050 for the purchase of the Amersham undertaking. [*Parliamentary Agent: Mr. R. A. Read.*]

The Witney and District Gas Company, Limited, are in evidence with an Order asking for, among other things, further works powers. The limits of supply are defined; and then it is proposed to be enacted that the capital shall not for the purposes of the undertaking exceed £25,000, comprising the original ordinary and preference share capital of £8000, and £17,000 additional capital, to be issued in accordance with the conditions of the latest form of auction and tender clause. The standard rates of dividend are named for the original capital of 10 per cent., for the additional ordinary capital 7 per cent., and for the preference capital 5 per cent. Including £5000 of 4½ per cent. debentures already issued, borrowing power is proposed at the usual limit of one-third. Land, works, and other clauses are in common terms. The prescribed illuminating power is 14 candles, tested by the "Metropolitan" No. 2 burner. The maximum price of gas, it is proposed, shall not exceed 5s. 3d. per 1000 cubic feet in Witney, and 6s. in the parishes of Hailey Minster Lovell, Curbridge, Cogges, and Ducklington. A revision of the maximum price, or substitution by standard price and sliding-scale, is arranged for. In all other respects the clauses follow the model ones. [*Parliamentary Agents: Messrs. W. & W. M. Bell.*]

There are four applications for Provisional Orders to the Local Government Board to be noticed.

The first is from the Borough of Chipping Norton. The Mid-Oxfordshire Gaslight and Coke Company, Limited (now in liquidation) are the owners of the gas-works situated in the borough; but the Company or any person (other than the Corporation) are not authorized by Act of Parliament or Order to supply gas for public and private purposes. The Corporation claim that under the Public Health Act, 1875, they are empowered to supply gas in the borough; and they are applying to the Local Government Board to issue a Provisional Order accordingly. They ask for power to purchase land, construct and maintain works, and to acquire the whole or any part or parts of the existing works within the borough as may be agreed upon. The standard quality of the gas to be supplied is placed at 14 candles, tested by the "Metropolitan" No. 2 burner. The maximum price of gas is proposed at 5s. per 1000 cubic feet; and in close proximity is the old 10 and 15 per cent. discounts clause. It is also proposed to be enacted that the price charged for public lighting shall not be less than that charged to private consumers by more than 10 per cent. The financial provisions are all of the stereotyped form. [*Parliamentary Agent: Mr. Wellington Taylor.*]

The Cudworth District Council are at present supplying in their area gas purchased in bulk from the Barnsley Gas Company; but now they want to be in a position to construct works of their own in order to themselves manufacture the gas they purvey, and to supply in bulk outside their district. Lands are scheduled for the works, and powers are sought for their construction and maintenance. The prescribed illuminating quality of the gas to be supplied is placed at 14 candles, tested by the "Metropolitan" No. 2 burner. The usual financial provisions are incorporated, among them being one conferring borrowing powers with the sanction of the Local Government Board. [*Parliamentary Agents: Messrs. Durnford and Co.*]

The Corporation of Droitwich are seeking permission to purchase additional lands for gas-works purposes; and, at the same time, it is desired that the illuminating power of their gas shall be prescribed at 14 candles, as tested by the "Metropolitan" No. 2 burner. A few other clauses appear of ordinary type. [*Parliamentary Agents: Messrs. Sharpe, Pritchard, and Co.*]

The Corporation of Liverpool own gas-works, and supply gas in the township of Fazakerley; and they have introduced the draft of an Order proposing that so much of their Order of 1906 as provides that the burner to be used for testing the gas at Fazakerley shall be a batswing or fishtail burner shall be revoked, and in lieu thereof the "Metropolitan" No. 2 burner be adopted. The Board of Trade, it is proposed, shall have the power to approve (on the application of the Corporation) of any other burner suitable for testing. The conditions and regulations applying to the use of the burner are, with but a few verbal changes, the same as those that appear in the Standard Burner Acts of last session. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

There are only two applications under the Private Legislation Procedure (Scotland) Act to be referred to here.

In the application of the Aberdeen Corporation, it is pointed out that, for the purpose of certain assessments, provision is made by the Aberdeen Corporation Act, 1891, for the valuation of underground gas and water pipes and underground works connected therewith at one-fourth of their yearly value; and it is now proposed that a similar provision should be made with respect to underground electric mains and lines and underground works connected therewith. Among a number of other miscellaneous provisions is one affecting the regulations applying to traffic on the gas-works railway. It is proposed to amend section 53 of the Aberdeen Act of 1883 by prescribing that the maximum rate of speed for trains upon the railway shall be 5 miles per hour, instead of 4 miles; that the maximum number of waggons or trucks in a train shall be eight instead of five; and that the person appointed to walk in advance of the locomotive shall give sufficient warning of the approach of the train by means of a whistle, or other suitable instrument, and shall not be required to display a red flag. It is also in contemplation to repeal the restriction as to the running of trains only during certain hours. [*Parliamentary Agents: Messrs. Martin and Co.*]

In a schedule to the Dunfermline Order, lands are described which the Town Council as the Gas Commissioners desire power to use for gas-works purposes. The Order is chiefly for the extension of the burgh; and it is requested that the area of the supply of gas shall be coterminous with the enlarged area. [*Parliamentary Agents: Messrs. Beveridge, Greig, and Co.*]

WATER BILLS FOR 1911.

[First Article.]

In the four preceding issues of the "Journal," and again to-day, the principal features of the Gas Bills and Provisional Orders to come before Parliament in the approaching session have been indicated. We now commence to notice the measures relating to water supply, taking first the Bills promoted by Companies.

The Chester Water Company apply for the confirmation of their existing works for drawing water from the River Dee, and of the acquisition of lands and the expenditure of capital in connection therewith. The works consist of the intake used by the Company for abstracting or diverting the water from the river, and the main or pipes laid from that point to the pumping-station at Barrel Well, Boughton. The lands for the purchase of which confirmation is required are situated in the parish of Chester, and are now in private occupation. Authority is sought to construct and maintain other works, consisting of a subsiding tank or reservoir to be constructed on land near the Eaton Road, leading from Chester to Eccleston, and an aqueduct, conduit, or line or lines of pipes commencing at the intended reservoir, and terminating by a junction with an existing main of the Company. Six years are required within which to complete these works. The Company wish for power to enforce the provisions of the Rivers Pollution Prevention Acts, 1876 and 1893, or of the Public Health Acts, in order to prevent the pollution of any waters over which they have power of user. The Bill contains provisions enabling the Company to fix and maintain the necessary apparatus for the detection of waste, to sell or let meters, and to supply water in bulk. It is proposed to convert the existing stocks and shares of the Company; the substituted stocks to be held on the same trusts as the others. The Company require authority to raise additional capital, not exceeding £80,000, by the issue of ordinary or preference stock; to borrow in respect thereof any sum or sums not exceeding in the whole (inclusive of £14,550 already borrowed under the powers of their Acts of 1857 and 1874) one-third of the amount of the capital actually raised at the time of borrowing; and to create debenture stock, subject to the provisions of the Companies Clauses Act, 1863. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

Authority is sought for the incorporation of a Company with

power to construct works and supply water within the rural district of Ely, and the parishes of Fordham and Soham in the county of Cambridge. The capital is put at £30,000, in £1 shares; and authority is sought to borrow to the extent of one-third, and to create and issue debenture stock. It is proposed to construct in the parish of Fordham a well and pumping-station, and a line of pipes commencing thereat, and terminating in a reservoir or water-tower; a well and pumping-station in the parish of Wilburton; a well, pumping-station, and water-tower in the parish of Haddenham; a line or lines of pipes in the parishes of Coveney and Downham; and a reservoir or water-tower in the parish of Littleport. The works are to be commenced within three, and completed within five, years from the passing of the Bill. The rates at which water is to be supplied for domestic purposes are based upon the rateable value of the premises; starting at 8s. 8d. where this does not exceed £5 per annum, and rising to 5 per cent. when it is above £100. Additional closets and fixed baths are to be extras. Where the supply is by meter, the rate is to be at the most 1s. 6d. per 1000 gallons. Power is sought to sell water in bulk for supply beyond the limits specified in the Bill; and to require the owner or occupier of any house, situated at a higher level than 50 feet above Ordnance datum, receiving or requiring a supply of water from the Company, to provide a suitable cistern, under liability to a penalty not exceeding £5 for default. Provision is made for the purchase of the undertaking by the Ely Rural District Council at any time after 25 years from the passing of the Bill; and the price to be paid is to be a gross sum representing the market value of the concern, without any allowance whatever for compulsory purchase. [*Parliamentary Agents: Messrs. Baker and Co.*]

The Felixstowe and Walton Water Company apply for authority to construct additional works, consisting of a pumping-station in the parishes of Rushmere St. Andrew and Foxhall, another wholly in the latter parish, a covered service reservoir in the parish of Purdis Farm, and three pipe-lines. Confirmation is sought for the Company's existing pumping-station in the parish of Trimley St. Martin and the pipes now laid down. The Company require power to raise additional capital not exceeding £42,000 (including premiums), by the issue of either ordinary or preference shares, to borrow to the extent of one-third, and to create debenture stock. The dividend is to be limited to 7 per cent. upon the ordinary and 6 per cent. upon the preference capital. The other provisions of the Bill are of the usual character. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The Luton Water Company seek authority to acquire additional land by agreement for the general purposes of their undertaking, and to raise more capital. The quantity of land is not to exceed 6 acres in extent; and its use is to be restricted to the erection of buildings. The amount of additional capital applied for is £100,000, to be issued as consolidated ordinary stock; and it is, of course, to be sold by auction or tender. Power to borrow to the extent of one-third, as well as to issue debenture stock, is required, the dividend on which is not to exceed 4 per cent. per annum, without the consent of the Board of Trade. Authority is required to create a special purposes fund. [*Parliamentary Agents: Messrs. W. & W. M. Bell.*]

The Bill of the West Cheshire Water Company is to obtain legislative sanction for their existing works in the hundred of Wirral and county of Chester, and also authority to raise additional capital. The works comprise a well and pumping-station in the township of Prenton, boreholes and a pumping-station in the township of Childer Thornton, a water-tower in the parish of Heswall, and a pumping-main or line of pipes commencing in Prenton and terminating at the water-tower just mentioned. The amount of additional capital required is £40,000, or not exceeding £50,000 with premiums, to be entitled to a dividend of 7 per cent. per annum if raised as ordinary capital, or 5 per cent. if as preference. Power is sought to borrow to the extent of one-third of the amount of capital actually raised at the time of borrowing, as well as to issue debenture stock. Not more than 5 per cent. per annum is to be paid on money raised on mortgage or debentures, without the sanction of the Board of Trade. [*Parliamentary Agents: Messrs. W. & W. M. Bell.*]

The Wirral Water Company also wish to have the construction of their works confirmed. They consist of a pumping-main or line of pipes in the township of Prenton, already referred to in connection with the Bill of the West Cheshire Water Company, and two reservoirs in the same township. The Company wish for authority to raise additional capital to the amount of £5000, or £6000 with premiums, to be entitled to 7 or 5 per cent. per annum according as it is issued as ordinary or preference capital; and also to borrow to the extent of £16,660 in respect of the original capital of £50,000 existing at the time of the passing of the Bill, and £1666 in respect of the additional capital. No part of the last-mentioned sum is, however, to be borrowed until the whole of the additional capital, with premiums, has been paid up. The limit of interest on money raised on mortgage or debentures is 5 per cent. per annum, unless the Board of Trade sanction payment of a higher rate. [*Parliamentary Agents: Messrs. W. & W. M. Bell.*]

Commercial Gas Company's Dividend.—We learn that, subject to audit, the Directors of the Commercial Gas Company will recommend dividends at the rate of £5 9s. 4d. per cent. on the 4 per cent. stock, and at the rate of £5 6s. 8d. per cent. on the 3½ per cent. stock, for the half year ended Dec. 31 last.

EARLY HISTORY OF STANDARDS OF LIGHT.

In connection with the paper on "Flame Standards Used in Photometry," presented by Dr. E. B. Rosa and Mr. E. C. Crittenden at the fourth annual convention of the American Illuminating Engineering Society, as given in the "JOURNAL" for the 3rd inst. (p. 32), a paper on "The Early History of Standards of Light," submitted by Mr. E. L. Nichols at a meeting of the New York Section of the Society early last month, possesses special interest. We therefore make the following extracts from the full text of the paper in the December "Transactions" of the Society.

The year 1884 is a convenient epoch at which to close what may be termed the early history of photometric standards. In that year, for the first time, the condition commonly recognized by photometricians as essential to the satisfactory primary standard of light—that is, the maintenance of a substance of definite composition in a constant and reproducible state of incandescence—was reasonably fulfilled by means of the Hefner-Alteneck amyl-acetate lamp. In 1884, likewise, the first international agreement upon a standard of luminous intensity was reached by the adoption of the Violle standard by the Paris conference. The present notes, for which no claim of completeness is made, deal with the period prior to 1884.

The Candle.

The beginnings of photometry were astronomical. Even before the time of Bouguer (1729), who is commonly regarded as the father of the science, attempts were made by Huyghens to estimate the relative brightness of the sun and of the fixed star Sirius. He expressed the intensity of the star in terms of the portion of the sun's disc which, when viewed through the telescope, would present a corresponding appearance. Bouguer estimated the intensity of sunlight and of moonlight directly in candle power; and he seems to have regarded the candle as the most convenient and obvious photometric standard.* He did not go further in designating what a standard candle should be than to speak of carefully selecting those that were of the same size. Lambert, in his "Photometria" (1760), also used candles in his photometric experiments.

Rumford (1794) went farther than his predecessors. In his description of his improved photometer, he says: "To fill the important office of a standard of light with which all others are compared, I have chosen a wax candle of the first quality, just eight-tenths of an English inch in diameter, and which, when burning with a clear and steady flame, has been found to consume very uniformly 108 grains Troy of wax per hour." Rumford, who deserves to be acclaimed as the first of illuminating engineers, was engaged at this time in the construction of various public institutions for the Bavarian Government. As a part of this work, he attacked the problem of artificial lighting in a truly scientific spirit. He investigated all the existing sources of light, recognized the superiority of lamps of the argand type (which had been invented in 1784), and devised multiple-wick burners of 50 candles or more. It was to study these light sources that he perfected the shadow photometer of Lambert, which became in his hands an instrument of precision.

It was in planning the Houses of Industry for the poor in Mannheim and Munich that the problem of adequate lighting was forced upon Rumford's attention. "In lighting up these spacious establishments," he says, "I first learned to know how much room there was for improvement in the art of illumination." How well he appreciated the need of the scientific method in illumination is clear from the following quotation: "What vast sums are expended in dispelling the obscurity of the night in every part of the world; and yet in what a deplorable state is the science which ought to elucidate all the details of that important operation! How is it possible to labour with any prospect of success to improve the methods employed in illumination, so long as we remain so perfectly ignorant respecting the nature of light?" This was written at a time when Rumford was busy devising experiments to overthrow the emission theory of light and the caloric fluid theory of heat.

Rumford had no illusions as to the reproducibility of the candle in any broad sense. He sought only a reasonable constancy of standardization for his own experiments; and to secure this he selected in advance his stock of candles, which he hoarded carefully—realizing that, on replenishing his stock, he would not be likely to be able to duplicate them. He found argand burners to afford greater steadiness than the candle, but not to be depended upon from day to day without calibration. He therefore used an argand lamp as a secondary standard; comparing it before each set of observations with the candle, and using the latter only to check the performance of the lamp.

The British standard candle is usually spoken of as the oldest of such standards; and this is doubtless true so far as legalized standards are concerned. It was defined by Parliament as a standard spermaceti candle seven-eighths of an inch in diameter, and burning 120 grains in the hour. Candles were, however, employed in England for photometric purposes at a much earlier day. According to Dibdin,† Murdoch used tallow candles in gas photometry in 1808. His standards weighed six to the pound,

* "Traité d'Optique," p. 4, *et seq.*

† "Public Lighting by Gas and Electricity" (p. 34).

and consumed 175 grains per hour. Leslie (*vide* Dibdin), in his photometric work, adopted the wax candle as his standard.

The German candle, or *Vereins-kerze*, appeared in 1882, more than twenty years after the British candle. It was a paraffin candle 20 mm. diameter, having a flame-height of 50 mm.; and it was the result of fourteen years' labour on the part of a Committee of the German Association of Gas and Water Engineers. This was clearly a case where, to turn an old saying about, the candle was not worth the game; for, in spite of the long-continued painstaking investigations of which it was the product, it was but a slight improvement upon the British candle. The same may be said of the other German standard, known as the Munich candle. The latter was a stearine candle 23 mm. in diameter at the base, 20·5 mm. above, and 310 mm. long; and the normal flame-height was 52 mm. It attained local application as temporarily the accepted standard in an agreement between the city of Munich and the manufacturers of gas.

The "star" candle of France had a much earlier and less pretentious origin. About 1830, De Milly discovered a cheap method of separating stearic acid from glycerine and other substances in fats; and, in partnership with Motard, he established a factory near the Barrière de l'Etoile, in Paris, whence the name *bougie de l'Etoile*. Peclet, who tested the first products of this factory in 1830, found the candles to burn 10 grammes an hour, and to equal one-seventh of a Carcel in brightness. Palaz* remarks that such candles are no longer to be found in France, the best not giving more than one-eighth of a Carcel. In England, on the contrary, according to Heisch and Hartley, modern candles (in 1884) were giving more light for the same consumption of spermaceti than was formerly the case.

The fourteen-year campaign of the German Committee is only one example of the incredible amount of work done in the attempt to make of the candle a satisfactory photometric standard, and to determine what, from the very nature of the case, is indeterminate—*i.e.*, the exact relations of the various candles to each other and to other photometric standards. And yet it was only necessary to substitute for the eye a suitably constructed bolometer and a quick-acting galvanometer of sufficient sensitiveness, and with such an instrument to record the life-history of any candle, as was done by C. H. Sharp and the late C. P. Matthews in 1896, in order to demonstrate once for all the worthlessness of such sources of light as photometric standards.† [The author reproduced from the report of a Committee of the Institution of Electrical Engineers diagrams illustrating the typical behaviour of the British standard candle and the German candle burning under the best conditions that the photometrists were able to secure.]

With such evidence of the utter unreliability of the candle as a photometric standard, it is easy to understand the discrepancies of the early attempts to reach some common ground, and to bring the various candle standards into accord. The long-continued and laborious efforts of the English, German, Dutch, and French photometrists in this field is a monument to the extraordinary conservatism of the human race, and to its fondness for clinging to things of the past, however imperfect.

The Carcel.

This source of light, which is a modification of the oil-lamps with central draught invented by Argand, was devised by Carcel and Carreau in 1800. It does not appear to have been originally intended as a photometric standard but for general domestic service. Argand's original lamp was described in the "Journal de Physique" in February, 1784; and it revolutionized the artificial lighting of the period. Some years later, Lange modified the glass chimney by adding the contraction at the base of the flame. Carcel's contribution consisted in the mechanical device for keeping the wick uniformly flooded with colza oil; and this added greatly to the steadiness and reliability of the lamp. In the ninth year of the French Republic (1801), it was recorded that "Citizen Guyton reported on the mechanical lamp of Carcel and Carreau." "This lamp," he declares, "is designed to add a new degree of perfection to lamps with central draught, as regards intensity, economy, and convenience for daily use."

The Carcel lamp owed its introduction as a standard to the labours of Arago and Fresnel. These eminent men of science were for many years engaged in the improvement of the lighthouse service of France. In 1822, Fresnel, in his memoir "On a New System of Coast Lights," used the Carcel as the standard in terms of which to define the power of the special oil-lamps with several concentric wicks which were being introduced into his lighthouses. One of these had an intensity of 17 Carcels (160 candles). Arago and Fresnel also made an extensive study of the performance of illuminating gas, with the idea of installing isolated gas plants at some of the more important lighthouses, and of substituting large gas-burners of Argand's type for oil-lamps. In this study, they likewise used the Carcel as a photometric standard; and when, in the year 1845, an agreement was made between the Government and the Company supplying gas for public lighting in Paris, they specified, on behalf of the City, the performance which was to be demanded in terms of the Carcel.

In 1856, complaints as to the poorness of Paris gas led to the appointment of another Commission, consisting of M. Dumas, the chemist, and M. Regnault—two of the most illustrious experimenters of their time. They made further detailed studies of the Carcel lamp, determined the effects of height of wick and of the position and diameter of the contraction of the chimney, and established standard conditions for its use. They specified 42 grammes of colza oil per hour as the normal consumption; having found this to be the amount which gave the best results. They said frankly that it was difficult to indicate in a general manner the conditions under which the Carcel lamp would give a determinate and constant effect; that two lamps having the same diameter of wick and the same capacity would differ in consumption and in brightness; and that the temperature of the lamp, the duration of burning, and the amount of oil in the lamp would affect the intensity of the flame. They found that, before using the Carcel lamp as a standard, it was necessary to determine experimentally the conditions under which it individually would give the greatest constancy of performance. In spite of all these difficulties, MM. Dumas and Regnault drew up official specifications for a standard Carcel lamp to be used as the reference standard in testing the gas of Paris; and it became the legal standard for the city, and indeed for all France. Its merits were violently contested by English and German photometrists; but it continued to be so warmly advocated by those who were long accustomed to its use that at the first sitting of the International Conference in Paris in 1881, it was adopted as the temporary practical unit pending the establishment of an absolute standard.

Platinum Standards.

The first definite suggestion of the use of incandescent platinum as a standard of light was made by Mr. J. W. Draper in 1847, in his classical memoir on the temperature at which incandesence begins, and on the development of the visible spectrum with any further rise of temperature. He determined the temperature of a strip of electrically heated platinum by measuring its elongation. Forty years later, the present writer, in a more detailed study of the visible radiation as a function of the temperature, made use of the expansion of the metal as a criterion of its state of incandescence, though quite without reference to its use as a photometric standard; and he is still of opinion that this affords the simplest indication, and one which is much less subject to variations on account of the impurity of the metal, &c., than the measurement of the electrical resistance.

In 1857, Friederich Zoellner, the German astrophysicist, considered, in the course of his series of photometric studies, the practicability of a standard of incandescent platinum, the intrinsic brightness of which was to be defined in terms of the heating current; but he was unable to establish any simple relation between the luminous intensity and the current. Schwendler, in 1878, revived this idea in modified form, but without success. The inherent difficulty, as has been pointed out by Liebenthal, lies in the rapid disintegration of the platinum, whereby the temperature for a given strength of current is subject to considerable change.

In the following year (1879) appeared in its first form the platinum unit of Violle, which five years later was adopted by the International Conference in Paris as the fundamental unit of luminous intensity. This unit has much to recommend it. In the first place, temperature cannot be more directly and accurately defined than by the melting-point of a pure metal. The composition of the light from melting platinum corresponds more nearly to that of modern light sources than that of candles or of the Carcel, Hefner, or pentane standards. The increase of intensity to about 20 candles is a distinct advantage. The history of the abandonment of the platinum unit of Violle (largely as the result of Lummer's adverse report), on the score of impracticability, and the discussion of the various modifications and substitutes proposed, do not belong to the period here being considered. It should be noted, however, that Petavel's experiments, in which hydrogen was used instead of coal gas in the blast lamp for melting the platinum, indicate that Violle's standard is neither impracticable nor inaccurate.

Conclusions.

The demand for accurate and reproducible standards of light arose with the development of the two great industries of gas lighting and electric lighting. Gas photometrists and electrical engineers worked at the problem quite independently, and have been long in reaching a common ground. Real progress began only with the definite abandoning of the candle, and the search for new sources of light. Most of the work belongs to a later period than that covered by these notes, though several of the most interesting and important investigations had their origin before the year 1884. Thus the Harcourt pentane lamp made its first appearance in 1877, and the gas standards of Methven and Giroud date from 1878 and 1882 respectively.

Exceedingly interesting proposals made independently by Violle, Swinburne, Thompson, and Blondel, to use the light from the positive crater of the carbon arc as a photometric standard were based upon Abney's observation in 1878 of the constancy of the intrinsic brightness of this source. This proposition, which, like that of Violle for a platinum standard, was abandoned as infeasible, would seem to have a sound foundation, seeing that the constancy of the temperature of the surface of the crater has since been established by the investigations of Waidner and Burgess at the United States Bureau of Standards. Complete reproducibility would be a question, therefore, of control of the location of the crater, and of the use of a standard quality of carbon.

The really serious attempts at standardization in these various cases occurred, however, after the close of the period with which the present paper has to do, and form a part of the modern, rather than of the early, history of photometric standards.

* "Photométrie Industrielle" (p. 107).
† See "Journal," Vol. LXVIII., p. 20.

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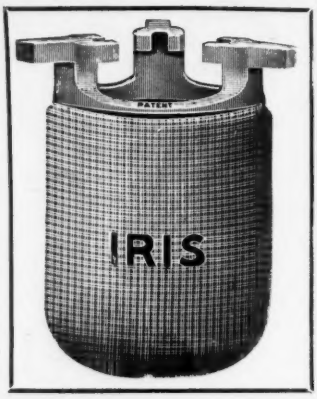

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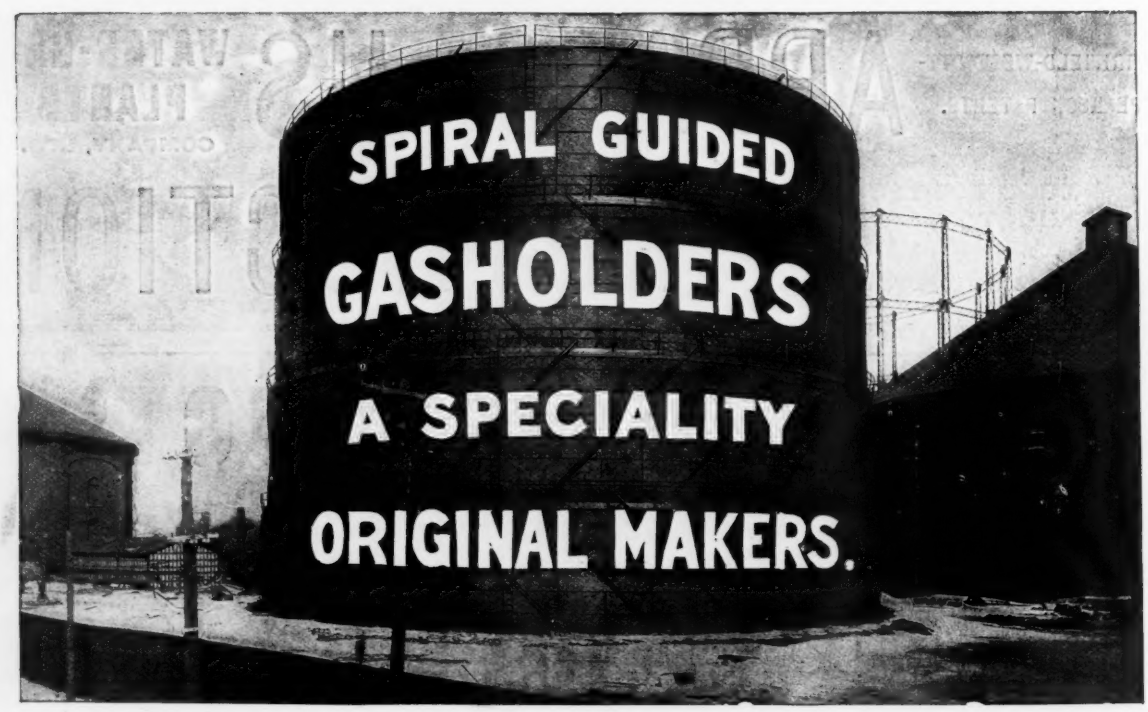

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NOTES ON THE WORKING OF HEAVY CHARGES.

By G. M. Gill.

Rather more than a year ago, the writer contributed some notes to the "Journal,"* describing his first experiences with heavy charges in horizontal retorts. In discussing the various details which required attention in changing over from small to large charges, he stated that it had been possible to greatly increase the quantity of coal carbonized per retort in twenty-four hours. In fact, it was stated that, when comparing 6-hour with 10½-hour charges, it had been found possible to increase the quantity of coal carbonized per retort in twenty-four hours from 25 cwt. to nearly 30 cwt. This was the position at that time; though, it should be mentioned, that further experience proved that a considerably higher make per ton could be obtained by reducing the quantity to 28½ cwt. This was done in spite of the fact that it resulted in a lower make per mouthpiece.

The Difficulties of Twelve-Hour Charges.

As regards make per mouthpiece, the eight-hour charge takes a great deal of beating; but it appears to the writer that it is to some extent a question of the size of the retort. If the retorts are small—say, 22 in. by 15 in., or less—there is undoubtedly a difficulty, where it is a practice to work high heats, in charging them up with sufficient coal to last twelve hours, with the result that many of the charges are burnt off in ten or eleven hours, and the output of gas is consequently reduced. With the eight-hour charge, however, there is no difficulty in this direction; and should it be the practice to use (say) 9½-cwt. charges, the retort is easily filled to this extent, and, if well carbonized to yield 11,750 cubic feet per ton, the quantity of 28½ cwt. used in the twenty-four hours will yield a mouthpiece make of 8371 cubic feet. Now with the twelve-hour charge, to use the same quantity of coal in twenty-four hours, a retort must be filled each time to the extent of 14¼ cwt. To do this consistently, and as an average charge in a D retort no larger than 22-inch by 15-inch by 20 feet, is, in the writer's experience, a matter of impossibility. In fact, the average quantity inserted per charge over a long period in practice has not amounted to more than about 13¼ cwt. The result of this is that about 2 cwt. less coal is carbonized per retort per twenty-four hours with the twelve-hour system, as compared with that of eight hours, resulting in a lower make per mouthpiece, though not substantially so, owing to the increased make per ton obtained with the larger charge. Thus, to give an instance, should a make per ton of 12,250 cubic feet be obtained by carbonizing in twelve-hour charges, the smaller amount of coal used—viz., 26½ cwt.—per retort will result in a mouthpiece make of 8115 feet, as against 8371 feet with the eight-hour charge and the lower make per ton. Even so, the larger make per ton is infinitely more valuable from a financial point of view than the larger make per mouthpiece.

The writer's recent experiences with filled-up charges may possibly be of interest. In the article previously referred to, it was explained that, owing to the above-mentioned difficulty, 10½-hour charges had been adopted in preference to those of 12 hours, after the latter had been accorded a trial. This system—that of 10½ hours—is a very good one indeed in many ways, as it is possible with a certain size of retort to gain the advantages of both eight-hour and twelve-hour charges without the disadvantages of either. It is, however, an awkward system in other ways, and it is, moreover, inconvenient to have a different time-table every day. For this and another reason (to be explained later), it was decided to again try twelve-hour charges. But on this occasion the precaution was taken of first scurfing all the retorts and increasing the pressure on the Arrol-Foulis charging machine, with a view to packing the charge more tightly. This certainly improved matters; but it was found impossible to carbonize as much coal per twenty-four hours as with the 10½-hour charges, owing to the machine being unable to insert more than an average of 13¼ cwt. per charge in the 20-feet by 22-inch by 15-inch D retorts, as compared with the charge of about 13 cwt. with the 10½-hour system. The make per mouthpiece did not, however, drop proportionately to the reduction in the quantity of coal carbonized per twenty-four hours, as there was an undoubted increase in the make per ton, and, practically speaking, no difference was noticed in the quality of the gas. The advantage in the make per ton from the twelve-hour system outweighed the increased output of gas from the 10½-hour system, and especially as there are other advantages on the side of the longer system.

On the adoption of the twelve-hour charges, there was experienced an increase in the heat of the settings; and to keep them from getting too hot, it was necessary to reduce all the dampers. This was probably due to the fact that less coal was at the time being carbonized.

Working with Two Eight-Hour Shifts.

As soon as the twelve-hour charges had become an established success, two eight-hour shifts were adopted in place of three eight-hour shifts, and a very considerable economy in labour charges resulted from the alteration. One shift worked from 6 a.m. to 2 p.m., and the other from 6 p.m. to 2 a.m.; and it may further be added that recent experience has shown that these hours are popular with the men. Working in this manner there are two four-hour intervals—one in the morning and one at night—when no carbonizing operations are proceeding. It is, of course, obvious that this system is only possible in moderate-sized retort-houses, and where the machines are capable of doing the entire daily work in sixteen hours out of the twenty-four. Again, it could not be adopted except where twelve-hour charges are in vogue, and where the furnaces will last unreplenished for six hours; for it is hardly feasible to fill the whole number of furnaces during the last hour and first hour of the respective shifts, and even if this were done, it would mean that they would have to last seven hours at one time and five hours at another time.

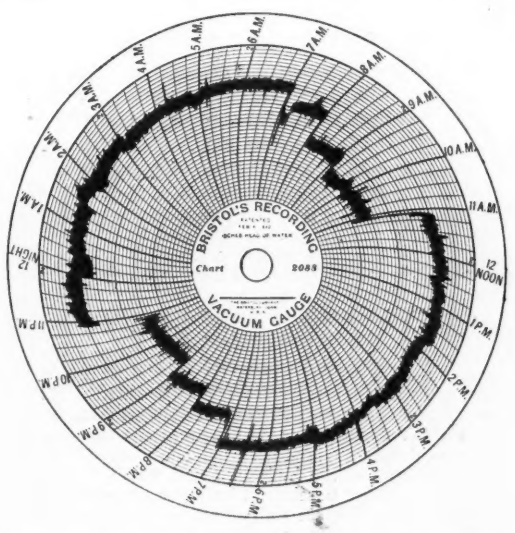
The two-shift system is proportionately more economical in small retort-houses than in large ones, owing to the greater difficulty of arranging the work economically in the former, so that each man may have an adequate amount of work to do, and yet so arranged that the operations are properly carried out. Every gas manager must have experienced the difficulty of carrying on retort-house work economically during the summer months with little more than half the number of settings at work.

Necessary Precautions.

Working with two shifts, there is no reason whatever why (say) eight sets should not be worked as cheaply per ton of coal carbonized as twelve sets with three shifts. The make of gas will, of course, vary from the time one shift goes off to the time the other shift comes on; and the quality will also vary to a comparatively small extent, provided that the retort-house governor is properly adjusted during the latter part of the interval and the commencement of the next shift. With twelve-hour charges, unlike those of six-hour, it takes a long time for the gas to be reduced very much in quality—as may be seen on a Sunday after shutting down. This variation is, however, reduced to a minimum with two retort-houses working on the two-shift system, and so arranged that one shift in one house is coming on when another shift in the other house is going off. In this way, one retort-house is making high-candle gas while the other is making low-candle gas; each thus counteracting the other. The writer introduced this system in two retort-houses nearly a year ago, and has so far had no reason to regret its adoption. There is, indeed, no doubt whatever that moderate and small retort-houses may be worked much more cheaply by this means than with the three eight-hour shifts. As a change from one system to another is never made without some difficulty, it will be of interest to describe in detail one method of maintaining a comparatively regular quality of gas which has been found successful in practice.

Variation of "Draw."

In the writer's experience, it has been found advisable to vary the vacuum maintained in each retort-house according to the hours at which the shifts are working. From the card here reproduced, it will be seen that the variation in the vacuum is regular and considerable during the hours in which no retorts are being charged. In the retort-house in question, the shifts work from 10 to 6 morning and night. The full "draw" is not commenced until at least one hour after the shift starts work, and until a considerable number of the retorts have been charged. This amount of



vacuum—usually 1½ inches for 1¾ inches seal—is maintained until one hour after the shift has finished work, at which time it is reduced by ¼ inch for one hour, and then again by a further ¼ inch for another hour. It is now three hours since any retorts were charged, and the "draw" is reduced to half the working gauge, or ¾ inch, until the next shift is fully at work. By this means, it is possible to make a fairly uniform quality of gas hour by hour, especially when the shifts in another retort-house are working from 6 to 2 morning and night.

Problematical Disadvantages.

The question naturally arises as to whether there is any appreciable loss of gas, owing to the somewhat severe reduction in the "draw" during the hours when no shift is at work. In theory,

* "Journal," Oct. 12, 1909, p. 103.

the reply might well be "Yes." But in practice the writer has found no such loss, either in the make per ton or in the make per mouthpiece, as compared with the results obtained when working three shifts. Where the seals are entirely in liquor—as in the case in question—and where the retorts are free from holes, the writer considers that the check put on the retorts during the hours when the house is idle and when most of the charges are half-spent, is merely sufficient to intercept the inferior quality of gas which it is desirable should be excluded. Certainly during these hours no escape of gas is visible issuing from either the shafts or mouthpiece doors; and, what is more to the point, the make of gas per ton of coal has increased by a considerable amount—to a figure exceeding 12,000 cubic feet—since three shifts were abandoned for two shifts. From all points of view, the writer, having had experience of both systems, is very much in favour of two shifts for any but large retort-houses, and considers that the substantial saving in the wages bill far more than counteracts any possible loss in gas, which, however, in the writer's experience, is more apparent than real, and which, in his opinion, need not occur if the retort-house is carefully worked.

Saving in Labour.

No engineer in charge of a retort-house fitted with horizontal retort-settings can afford to overlook the enormous saving which is possible by substituting a full twelve-hour charge for the popular six-hour charge of a few years ago. The writer has tabulated some figures to show the extent of the saving in one retort-house of his experience. Comparing twelve-hour with six-hour charges, the saving in wages is obviously very substantial; and it will be of interest to show from practical experience how much may be saved. The retort-house where the experience was gained consists of twelve settings of ten 22 in. by 15 in. by 20 ft. through Ω retorts heated by double generator furnaces, and operated before the heavy charges were introduced by Arrol-Foulis charging and drawing machinery. In April, 1909, the drawing machines were replaced by Williams and M'Phee's hydraulic pushers, and eight-hour charges, instead of six-hour, were instituted. In changing over from rakes to pushers with old retorts, there is invariably some difficulty in expelling the charges, owing to the fact that the drawing machines have a strong tendency to wear the retorts to a much greater extent near the mouthpiece than in the middle, thus causing the retort to assume a tapered shape in each direction from the middle. This is quite sufficient to prevent the pusher from readily discharging the coke until the retort wears away somewhat in the middle. This difficulty, though by no means insurmountable, is quite great enough to increase the labour costs temporarily; and thus the full saving may not be experienced for some time.

The following table shows the extent of the saving in labour costs, as each step was taken from six-hour charges with three eight-hour shifts to twelve-hour charges with two eight-hour shifts. A few other improvements were effected, and in each case the saving in labour due to these causes is shown; so that the actual saving resulting from heavy charges only may be readily observed.

Description of Work.	Number of Men Employed in Retort-House when Working.						
	Three Eight-Hour Shifts with Arrol-Foulis Charging and Drawing Machinery. 6-Hour Charges.	Three Eight-Hour Shifts with same Charging Machines, but with Coke Pushers. 8-Hour and 10½-Hour Charges.	Three Eight-Hour Shifts with same Machines. 12-Hour Charges.	Three Eight-Hour Shifts. Coal Broken by Machine Instead of by Hand. 12-Hour Charges.	Two Eight-Hour Shifts. 12-Hour Charges.	Two Eight-Hour Shifts. Hydraulic Mains Fitted with Tar Towers. 12-Hour Charges.	Two Eight-Hour Shifts. Charging Machine Cranes Fitted with Mechanical Slewing Gear. 12-Hour Charges.
Machine men	12	6	6	6	4	4	4
Clearing pipes, and shutting doors	18	27	24	21	18	18	16
Filling furnaces	6						
Sealing furnaces	3						
Repairing retorts, and clearing bridge pipes, and dip pipes	6	6	6	6	6	2	2
Clinkering furnaces	6	6	6	6	6	6	6
Quenching, trimming, and storing coke	9	9	9	9	8	8	8
Foremen	3	3	3	3	2	2	2
Total	63	57	54	51	44	40	38

It will be noticed that with six-hour charges sixty men in all were required; but it should be pointed out that their work included the breaking of coal, and the slewing by hand of two hydraulic cranes, attached to the charging machines, for the purpose of lifting from the store all the coal used in the retort-house. On replacing the drawing machines by pushers, it was found possible to dispense with six machine drivers; but the change to eight-hour, and later to 10½-hour, charges did not, for the reason stated above, result in the saving anticipated. This was, however, partly due to the fact that the lengthening of the charges made it possible to carbonize much more coal in the same retorts, and so somewhat increased the work.

The 10½-hour charges had no sooner been introduced with success than a change was made to the much simpler twelve-hour charge, with a further reduction of three men. At this time mechanical breakers were installed—an innovation which effected a further saving of three men. As soon as twelve-hour charges were found to be entirely satisfactory, it was decided to divide up the men into two instead of three eight-hour shifts. This was done with complete success and very considerable economy. Although the same amount of work remains to be done, it can be carried out much more quickly with plenty of men on each side of the house. This is invariably the case in a comparatively small retort-house, but, of course, would not apply with a large retort-house where the machines are almost constantly at work.

A few months after the two shifts had been commenced, the retort-house was dropped for repairs, and the opportunity was then taken of installing tar-towers; much trouble having been experienced in keeping the hydraulic mains free from thick tar and pitch. It was only possible to keep them in a workable state by continually clearing them with oil gas tar and iron bars. The introduction of the tar-towers entirely cured the trouble, and not only were the hydraulic mains kept perfectly free from any blockage, but what little trouble was previously found with stopped pipes since heavy charges were first adopted was also completely cured.

The clearing of bridge and dip pipes, and the top of the ascension pipes had formerly been the regular task of several men. The tar-towers were so successful that it was found possible to dispense with four men, and at the same time much improve the conditions under which the gas is made; so much so that the writer has little hesitation in saying that clear ascension pipes and clear hydraulic mains not only render a big make per ton possible, but easy of attainment. It was previously mentioned that it was necessary to slew two hydraulic cranes by hand—no light task, and one which was at the very first opportunity dispensed with by fitting hydraulic slewing rams, resulting in a further saving of two men's labour.

It will thus be seen that in all a reduction of 24 men, from 60 to 36, has been made in working the same number of settings; and further it should be mentioned that one fireman less is required. Of this number—viz., 24—the reduction of fully 15 has been due to the introduction of coke-pushers with twelve-hour charges in two shifts in place of drawing machines with six-hour charges in three shifts. And, as is well known, it is not only in the reduction of the labour costs that heavy charges are advantageous, for a substantial improvement is thereby made in the quality of the coke and tar, and in the quantity of gas and ammonia, and in some cases tar, produced per ton of coal carbonized.

Make of Gas per Ton and Production of Ammonia.

Filled-up charges have been mainly responsible for effecting improvements in these respects in the works with which the writer is connected. They are as follows:

Half-Year ending.	Length of Charges in Use.	Make per Ton.	Galls. Amm. Liquor 8·0 oz. (Dist.).
June, 1908	6 hour	11,141 cubic feet	33·91
Dec., 1908	6 ,,	11,382 ,,	34·69
June, 1909	6 and 8 ,,	11,482 ,,	33·54
Dec., 1909	8 and 10½ ,,	11,746 ,,	35·40
June, 1910	12 ,,	11,980 ,,	42·08
Dec., 1910	12 ,,	12,381 ,,	37·74

It will be noticed that there is shown with the largest make per ton a drop in the production of ammonia. To account for this, the writer inclines to the belief that the very thorough carbonization of the coal, even with full charges, will have a tendency to reduce the amount of ammonia produced. It was explained earlier in the article that to obtain a larger make of gas per ton of coal the size of the charges had been reduced. This fact may possibly account for the decreased production of ammonia.

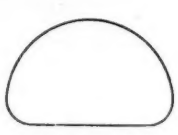
Shape of Retorts.

It is only to be expected that as experience is gained of any new system, certain details which were at first neglected should gradually come to be considered of importance; and it is more than probable that time will prove that the shape of the retort will have a very important bearing on the question of the successful working of heavy charges. Rather more than two years ago the writer had the opportunity of visiting the Bruges Gas-Works.

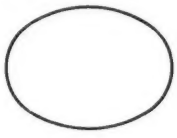
Among the many interesting points noticed was the shape of the retorts, which were similar to that shown; and he was informed by M. De Brouwer that the shape of the retort plays an important part in the ease with which the coke may be discharged by a pusher. It is seen that M. De Brouwer (than whom no engineer knows better) gives preference to a ⌂ retort of an unusual shape. It is very wide, but of about the usual height. The sides taper inwards from a point near the top, finishing off with a sharp radius at the bottom. It is found that the tapering of the sides allows the coke to rise slightly at the moment when the pressure of the ram is exerted upon it, and thus very greatly assists in its easy removal.

Shape of De Brouwer Retort.

During the past year, the writer's attention was again drawn to this interesting point in the working of a new retort-house fitted up partly with ⌂ retorts and partly with oval retorts. The retorts are 21-inch by 15-inch in size in each case, and are of the sections shown below. It was early noticed that the ⌂ retorts were



21-inch by 15-inch ⌂ Retort.



21-inch by 15-inch Oval Retort.

The Sections of the Retorts from the Working of which the Figures Quoted were Prepared.

much more liable to be jammed than the ovals; and the writer attributes the fact to the above-mentioned explanation—that the retort should taper outwards from the bottom to permit of the slight lifting of the coke. It will be seen that while the oval decidedly allows this movement to take place, the ⌂ retort is tapered inwards and does not allow the lifting of the charge. To prove that there is a difference between the two in practical working, the occasions on which the retorts were jammed and gave some difficulty in removal were carefully noted, and the figures show the following results.

⌂ Retort Settings. (7 retorts per setting)	Oval Retort Settings. (7 retorts per setting)
90 per set in 8 weeks' work.	59·5 per set in 8 weeks' work.

Unfortunately, however, the oval retort is the weaker of the two, and has a decided tendency to drop at the top; the arch being of a greater radius than in the case of the ⌂ retort. It would seem as though a round retort would give an excellent account of itself when used for heavy charges, possessing to a great extent the advantages of both shapes. Possibly some engineer will before long settle the point by giving a prolonged, practical trial to the round retort.

There are many other interesting points in connection with heavy charges which might, and which at a later date will, be touched upon; but, without labouring the point, the success of the system is well emphasized by the figures published in the recently issued Board of Trade returns, in which it is shown that in statutorily controlled gas-works an increase of 1632 million cubic feet of coal gas has been made in spite of a reduction of 169,000 tons in the amount of coal used—a truly excellent result, as was referred to in the "JOURNAL" for Dec. 13, p. 765.

In the course of a paper read by Engineer Rear-Admiral J. T. Corner before the Institute of Metals recently, he brought out the interesting fact that trouble from corrosion of metals on shipboard largely increased about the time of the introduction of the electric light afloat. The origin of the corrosion, he suggested, was chemical, induced by galvanic action, and was kept active by erosion.

A recent number of "Nature" contained an epitome, prepared from the "Revue Scientifique" of an address delivered by M. Le Chatelier, at the Collége de France, in connection with the ceremonies commemorating the centenary of the birth of Regnault, whose name is well known to our readers in connection with the Dumas and Regnault photometer. In the course of his address, M. Le Chatelier referred to several facts in the early life of Regnault which are not generally known. An orphan without means, he spent his youth as an assistant in a fancy bazaar, and at the age of twenty-two entered as a student at the Ecole des Mines. He rose immediately to a prominent position as one of the most promising pupils; and at the qualifying examinations held in May, 1834, after only two years of study, he passed brilliantly. For some strange reason, the Government refused to nominate him as a student engineer along with his successful fellow-students, but insisted on a further two years' course at the Ecole. During this period, he raised himself by his chemical researches to the front rank of chemists; and it was only on the appointment of a Government Commission on the steam-engine in 1843 that he commenced the series of measurements in the domain of physics which for accuracy remained unique for half-a-century.

PROFESSOR MARCHANT ON ILLUMINATION.

At the Meeting of the Liverpool Engineering Society last Wednesday, Dr. E. W. MARCHANT, Professor of Electrical Engineering at the Liverpool University, read a paper on "Illumination." The PRESIDENT (Mr. Edward Allen, M.Inst.C.E.) was in the chair; and among those present were Mr. R. E. Gibson, the Assistant-Engineer of the Liverpool Gas Company, Mr. Samuel Glover, of St. Helens, and Mr. Ernest Frith, of Runcorn. The following is an abstract of the paper.

Before dealing with the subject generally, the author reviewed briefly the history of lighting, with special reference to streets. For the sake of comparison, he gave the following list of the standards of illumination which are at present considered to be adequate for various purposes.

	Foot-Candles.
Desk	3 to 4
Machine shop	1 ,, 1·5
Drawing office	3 ,, 5
For reading	2 ,, 3
Well-lighted room	1 ,, 3
Railway station platform	0·05 ,, 0·5
Street	0·01 ,, 0·5

Contrasting modern lighting with what was formerly regarded as adequate, Professor Marchant remarked that the lady who seventy or eighty years ago illuminated her drawing-room with 16 candles would have thought she was giving a very good light; but the modern room with one 16-candle power incandescent lamp would be thought a very gloomy place. Even the illumination used to-day was far behind that given by daylight. The illumination of a white surface exposed to sunlight might be as great as 10,000 foot-candles; while in a room with the average window space in May, it varied from 20 to 40 foot-candles.

The author said it was difficult to write a paper such as the present without making some mention of the source of illumination employed; and if his references were mainly to electric lamps, it was because these and their use had come most prominently under his notice. But it was to be hoped that in the discussion there might be some account given both of lamps and methods of lighting which the paper did not deal with. This subject was one of the greatest possible importance alike to gas and electrical engineers. In the past, considerable attention had been given to improve the efficiency of the machinery for producing electric light; but far too little—at any rate until recently—to improve the lamp which was to use electrical energy to give light. The following extract from the well-known table published by Dr. H. Lux was given, to show that the percentage of the energy supplied to a lamp which is utilized for the purpose for which it is intended, is comparatively small:

Source of Light.	Watts Consumed per M.S. Candle Power.	Light Radiation. Energy Consumed. Per Cent.
Hefner lamp	116 0	0·103
14-inch petroleum lamp	47·0	0·25
Acetylene flame	17·6	0·65
Incandescent gas-light—		
Vertical	8·85	0·46
Inverted	7·75	0·51
Electric carbon filament lamp	4·55	2·07
Nernst lamp (excluding ballast)	1·93	4·21
Tantalum lamp	1·84	4·87
Osram lamp	1·79	5·36
Direct-current arc lamp (open)	0·925	5·60
,, ,, ,, (enclosed)	1·45	1·16
Flame arc lamp (yellow)	0·345	13·20
,, ,, (white)	0·51	6·66
Quartz mercury vapour lamp	0·255	6·00

Professor Marchant pointed out that for all practical purposes any body could produce the same kind of light as the sun, if it were raised to a sufficiently high temperature; and he said the chief reason for the increase in efficiency of modern electric lamps is that the temperature at which they burn is greater. The temperature of an Osram electric lamp filament, for example, is nearly 2000° C.; whereas that of a carbon incandescent lamp is only 1600° C. It has been shown by Lummer and Pringsheim that the amount of light issuing from a luminous body is proportional approximately, at high temperatures, to the temperature raised to the twelfth power; so that for very small changes—say, of 1 per cent. in temperature—the amount of light given is increased 12 per cent. This law does not hold in the case of sources of light such as flame arc lamps, where the increase in light is due to the presence of salts which give a colour to it. With the flame arc, the light is not like that from the sun, in that there are bands and patches in the spectrum due to selective emission from the salts. So far as incandescent lamps are concerned, however, the law stated above appears to hold fairly closely, although certain experimenters seem to have obtained evidence of some selective emission even in the case of tungsten filament lamps. The Welsbach gas-mantle is another example of selective emission; increase in luminosity of the mantle being largely due to selective radiation.

After some remarks on the measurement of illumination, and

references to the Trotter photometer and the Dow surface-illumination meter [the latter lately described in the "JOURNAL"], the author dealt as follows with the subject of the

ILLUMINATION OF INTERIORS.

It may be convenient to subdivide the remainder of this paper by considering first the illumination of interiors—*i.e.*, of spaces where the surrounding walls and ceiling exert some influence on the distribution of illumination. When electric light is used, the light is produced in nearly every case by incandescent lamps. The advantages attaching to this lamp are: (1) That the possible unit of light is a small one, and the illumination can therefore be readily controlled in accordance with the demand for light that may be made; and (2) that the light is completely enclosed, and gives no fume of any sort, or any contamination of the atmosphere. The first condition, of course, is one which is of no practical importance when the space that requires to be lit is a very large one; but the lighting of such large halls comes rather into the category of outside illumination, in that the effect of the walls in such a building is, as a rule, small. One of the most important considerations in the use of lights (and this may be said to be of particular moment when electric lamps are used) is the screening of the eye from the direct light from the lamps. The intrinsic brilliancy of a light—*i.e.*, the amount of light given off per square centimetre or per square millimetre of incandescent surface in the case of an electric filament lamp—is very high. [The author reproduced Dr. Stockhausen's table of the intrinsic brilliancy of the most common sources of light.]

It is now recognized very clearly that if the actual source of light is allowed to become focussed on the retina, the image it will form there is a very brilliant one, and the stimulus that will be given to the part of the retina on which the image falls, may be unduly severe. This is, the author believes, the reason why a good deal of the objection to electric light (on the ground, that it is bad for the eyes) has arisen. Lights intended for illuminating interiors should either be placed high up, where the eye is not likely to catch sight of them, or else be used with frosted bulbs and completely shaded. Another method of lighting which is now coming into quite common use, is to screen the lamps altogether behind a large projecting cornice, and obtain all the illumination from the lights scattered by the ceiling and frieze on which it falls. The disadvantage of this method is that it is very uneconomical, unless all the surfaces are kept of very good diffusing quality. For example, in the new lecture-hall of the Institution of Electrical Engineers, where this method has been employed, the expenditure of energy is nearly 2 watts per square foot of floor space to obtain an illumination of 2 foot-candles. At the same time, the effect obtained is very pleasant and restful to the eye. Another method, described in the author's paper on "Recent Progress in Electric Lighting,"* is to use a number of lamps uniformly studded over the ceiling of the room. The effect, as far as uniformity of light is concerned, is very good, and the efficiency is much higher; an illumination of nearly 3 candle-feet being obtained for an expenditure of less than one watt per square foot, with metal filament lamps.

After referring to the great advance that has recently been made in the use of shades, which will produce any desired illumination over a given area, the author passes to

EFFECT OF WALLS AND CEILING.

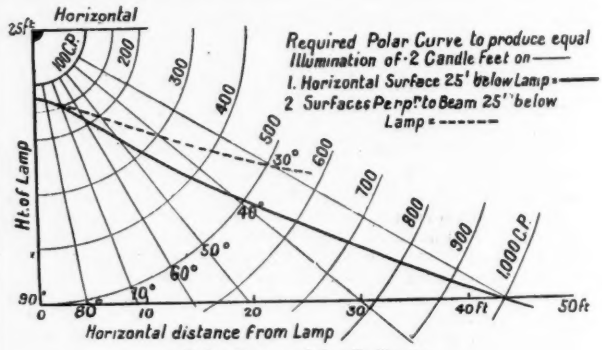
The nature of the influence which the reflection of light from the walls and ceiling of a room has on the general illumination is a matter of common knowledge, and the scientific principles involved are fairly obvious. If the light from a lamp falls on a surface and 90 per cent. of it is diffused or reflected, 9-10ths of the light is used over again; and the total illumination on a surface placed in a space lined on the inside with such a material will therefore be ten times as brilliant as if the whole illumination were due to the light alone.

The efficiency of illumination of a room may be defined as the ratio between the total luminous flux received on the surface which has to be illuminated and the total flux of light given out by the lamps. The total luminous flux on a surface is measured by the product of the intensity of illumination (usually measured in foot-candles) and the area (usually measured in square feet). The unit of length employed in both quantities must be the same. The total luminous flux from a lamp is $4 \times$ (mean spherical candle power), since a light of 1-candle power gives an illumination of one candle-foot over the surface of a sphere 1 foot in radius. The efficiency of illumination in a room may be greater than unity, where the effect of diffusion from walls and ceilings is taken into account. This quantity is a very useful one to know in respect of any given room, since it enables a more or less approximate determination to be made of the amount of light that must be produced to give any desired effect. Since the floors of most rooms absorb light and hardly diffuse any, the efficiency of lighting in an ordinary room is less than unity. In a small drawing-office in which the efficiency of illumination has been carefully measured, where the walls are of yellow "Duresco" applied to the plaster, with a white plaster ceiling and with an ordinary wood floor, the efficiency was found to be between 0·6 and 0·8. In a room with dark wall paper and dark carpet, but with white ceiling, the efficiency may be as low as 0·1 or 0·2 for a horizontal surface 2 or 3 feet above the floor; and in these cases a great deal may be done to improve illumination by using globes or shades which direct the light on to the area which requires to be illuminated, and prevent the light from being wasted or absorbed uselessly.

The effect of different colours of light is a matter of some practical importance, especially in view of the developments recently made in mercury vapour lamps. These lamps give out light of certain definite wave lengths. There is a strong violet light, a brilliant green, and a not quite so brilliant yellow. The effect of this kind of light on the eyes has been dealt with at some length in the paper already referred to; but two interesting points may be mentioned. (1) It is found that the Welsbach gas-mantle provides an excellent supplement to the light given by the mercury vapour lamp when the ratio between the two is about 0·6 to 1. It is doubtful whether this result is likely to lead to any mixed system of lighting; but it is remarkable that two lights which both appear to give a greenish-coloured light should combine to give a nearly white light. (2) The mercury vapour lamp, when used with tungsten filament lamps, also gives a very nearly white light when the ratio between the two is 1 to 0·53. The efficiency of mercury vapour lamps is usually such that they give about 1·7 mean hemispherical candle power per watt, and is not so high as that of arc lamps; but they have the advantage over the latter in not giving off any fumes.

EXTERIOR AND STREET LIGHTING.

This was the next subject taken up. The author characterized street lighting as "one of the most important branches of illumination." The best lamp to use for the lighting of any public thoroughfare is one that will produce a uniform illumination over a given area of which it forms the centre. There are two ways in which this condition of uniform illumination may be stated. The one most usually adopted is that the illumination on a horizontal surface at, or a given uniform distance above, the street level shall be the same at all points. The other depends on the illumination on a surface normal to the direction of the light. This latter definition is, however, not very satisfactory, and it is difficult to apply where more than one light is used for lighting a given point. The advantage claimed for the point of view taken in this definition is that sideways illumination casts definite shadows, and enables obstacles to be seen more clearly than would be the case if the rays of light were vertical.



Polar Curves of Candle Power.

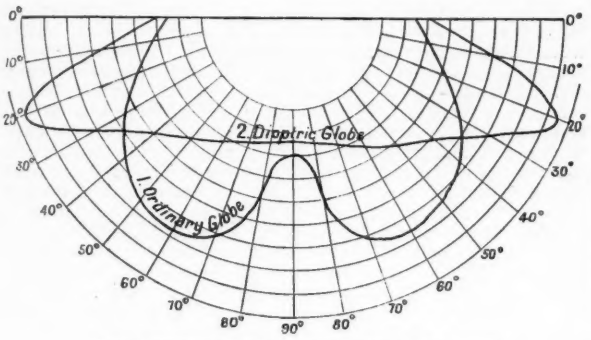
The above diagram is a curve which has been drawn to show the necessary distribution of light from a lamp to give uniform horizontal illumination, and also one to give uniform illumination on a surface placed normal to the direction of the light. A very little consideration of the curve will show any electrical engineer the type of lamp best suited for the purpose of street illumination—a vertical carbon arc lamp. In lamps intended for street lighting, therefore, unless special globes are used, the vertical carbon arc lamp is best suited to give uniform illumination.

The high efficiency of the "V" carbon flame arc lamp can, however, be made use of most effectively if suitable reflectors are used. The most successful of these is called the "Dioptric" globe, and was suggested in the first instance by Mr. A. P. Trotter. The globe is of glass, and is placed underneath the arc. It is made with a number of prisms cast on the lower surface, so designed that they deflect the vertical rays from the lamp in a nearly horizontal direction. By shaping the prisms suitably, any desired light distribution may be obtained. The effect that may be produced on the curve of candle power for a lamp is well shown in the diagram (p. 303), which has been plotted from results obtained with an "Excello" lamp. Without these globes, the light distribution is a maximum about 20° away from the vertical; and the shape of the light distribution curve is very far from that of the curves in the preceding diagram. When the globe is placed in position, the light-distribution curve approaches very near to the theoretical shape required for uniform horizontal illumination over a considerable area.

A very useful factor, called the "diversity coefficient," has only recently been advanced by Mr. Haydn Harrison. It is intended to give an idea of the amount of uniformity attained in any system of street lighting. This coefficient is defined as the ratio between the maximum and the minimum illumination. The factor may be as high as 30 or 40 (probably it would be of the order of several hundred in some bye-roads with scattered lights); but in a well-lit street it may be as low as 5, or even less, with modern lamps.

In connection with street lighting, a very important matter is "glare." The extent to which the effect of this is experienced

* See "JOURNAL" for Dec. 13, 1910 (p. 784).



Polar Curves of Candle Power of "Excello" Lamp.

varies greatly in different people, and depends upon the quickness with which the iris of the eye is able to adjust itself to new conditions. A rough definition which enables one to determine approximately whether or not the effect of glare is likely to be serious, is that the intrinsic brightness of any object seen should not be greater than 100 times the average illumination. This is, of course, a very rough definition; but it may be of some use for practical purposes. It gives, at any rate, a maximum value for the diversity coefficient in street lighting. An interesting point in this connection is that glare is much more noticeable when it strikes upwards to the eye, instead of downwards. This effect is well shown in the dazzling effect that is produced by reflection from snow, and also in the well-known glaring effect due to white, dusty roads. The consideration of glare is the basis for most of the rules that have been laid down in connection with the arrangement of lamps; and the position, so far as the placing of lights is concerned, may be summed up by saying that any source of light which gives a brightness more than 100 times the average illumination should be placed as far out of the direct line of sight as possible.

Absorption of Light by Fog.

The author said it would leave a serious gap in his paper if no mention were made in it of the absorption of light by fog. This was a matter on which it was very difficult to get any exact information; but one fact was generally recognized, and might be regarded as admitted by most people—viz., that the absorption of light by fog depended on its colour, and was greater for blue than for red lights. There was a scientific basis for this statement in the fact that it is well known that blue light is more readily absorbed than red by small particles in the atmosphere. Stated another way, the wave lengths of light which are commensurate with the dimension of the particles in the atmosphere are most completely absorbed. Where the wave length of light is long compared with the diameter of the absorbing particles, the absorption is less. This effect has been observed in lighthouses, where it has been found that in many cases the yellow light of oil-lamps can penetrate farther through a foggy atmosphere than the blue light of an electric arc which may nominally be much more powerful. The author said it was impossible to give exact figures, or anything approaching thereto, in the case of fog absorption, as so much depended on the nature of the fog and the exact constitution of the light that was being examined; and it was therefore impossible to do more than make a general statement.

Discussion.

The President moved a vote of thanks to the author, who, he said, had for some time been regarded as an authority on the subject of his paper. It was, of course, a fact that a great many of the principles underlying the subject of illumination by electricity were applicable also to illumination by gas; and those who were engaged in the gas industry had reason to be grateful for what had been done by Professor Marchant and others who happened to have a greater interest in electricity than they had in gas. It had been a generally accepted idea that the advent of electric lighting would result in a great deal of harm to the gas industry; but this had not been the case. Competition was always good for business; and the effect of the competition in this direction had been to enormously increase the benefits which the public derived from the use of gas. A volume of light was now being obtained from a cubic foot of gas 15 times greater than that which was obtained some years ago; and this was largely owing to the stimulus which had been given to the gas industry as a result of competition. He hesitated to criticize the table of Dr. Lux without knowing exactly the basis of the figures; but he was sure that if Dr. Lux had been dealing with high-pressure incandescent gaslight the percentage of light radiation to energy consumed would have been much higher than that stated in the table—probably four times the figure. He had had an opportunity of examining the Trotter photometer. It was a most interesting apparatus; but it appeared to him that very great care indeed was required in its use if serious error was to be avoided.

Mr. G. Carruthers Thomson said he had been reminded that in passing through Milan some years ago he had noticed that the lamps were hung in the centres of the streets at distances about 75 yards apart, and from 40 to 60 feet high; and the lighting was very well diffused all over the streets—there being no trouble with dark shadows. Upon returning home to Glasgow, the system of lighting there appeared to be a very crude one; the lights being placed on the sides of the streets at a height of about 25 feet from the ground. One part of the street was comparatively dark, and another brilliantly lighted and very uncomfortable to the eyes. The lights were subsequently placed in the centres of the streets, and at a greater altitude; and then the improvement was very marked. In Milan, the houses were painted in bright colours, which greatly assisted the illuminating effect.

Mr. W. H. Collis remarked that there was one subject upon which the author had not touched—viz., the lighting of shop windows. The object of the shopkeeper appeared to be to illuminate his customers, or prospective customers, rather than his goods. The larger number of the shops had a great glare of light outside; and on looking through the window the light was reflected into the eyes from the plate glass. If the lights were placed around the edges of the windows and well screened, the goods would be exhibited to much greater advantage.

Mr. W. E. Mills said that in the various towns in which he had made examinations he had found that the lamps were placed at too great a height. No one would be inclined to quarrel with the author's statement that "the best lamp to use for street lighting is one which will give a uniform illumination over a given area, of which it forms the centre;" but he (Mr. Mills) would like to ask whether the area of which the lamp should form the centre was a superficial one, or one that embraced a certain amount of the atmosphere; because it always appeared to him that arc lamps placed at considerable altitudes did as much to illuminate the roofs of the houses as to light the streets below. Probably there was some reason for placing the lights at so great a height; and, if so, he would be interested to have it explained. Referring to the sentence to the effect that "the illumination on a horizontal surface at, or a given uniform distance above, the street level shall be the same at all points," it appeared to contemplate the illuminating of an area above the street level; and if this were the right reading, why should the upper level require illumination from a street-lamp, which, he maintained, was intended to illuminate the surface of the roadways?

Mr. Brierly H. Collins asked the author what extra ratio he would allow in the lighting of a room the walls of which were covered with dark red paper over one papered in light green.

Professor Marchant, in reply, said he had been very much interested in the President's remark regarding the enormous increase in the illuminating power of gas-lamps. With reference to the efficiencies given in Dr. Lux's table, they were determined by the thermal power of the gas reduced to watts. Referring to Mr. Thomson's remarks as to the lighting of Milan, the reason why it was desirable to place lamps at a good height would be best explained by a diagram of curves of light at different altitudes. [The speaker made a sketch to illustrate his remarks.] He agreed with Mr. Collis in regard to the question of shop-window illumination. The large outside lamps were, of course, used for the purpose of advertisement. His reply to Mr. Thomson would cover a portion of the remarks of Mr. Mills. The superficial area referred to was that of the ground. Modern street-lamps were fitted with reflectors which prevented the light from going up into the sky. With regard to the measurement above the surface of the ground, it was more a matter of convenience. It was usual to specify so much illumination above the surface of the ground; 3 feet being recognized as the standard—as a convenient height. Replying to the question put by Mr. Collins, the ratio of light in a room with dark red paper to one with light green paper would be roughly 1·2 or 1·3 to 1.

At the close of the discussion, a number of appliances were exhibited and explained by the author. One of particular interest was a globe photometer recently installed by him for the testing of high-power electric lamps. It is believed to be the only one in the country; and by its aid the mean spherical candle power of a light may be ascertained by one reading.

Successful Arbitration by the Union des Gaz Company.

From our contemporary, "Il Gaz," we learn that a dispute between the Union des Gaz Company and their stokers at Milan (as to the number of men to be employed in the retort-houses) has been decided in favour of the Company. It seems this question was one of several left over for final settlement after the Italian gas-workers' strike of last year. The Arbitrators were Avv. D. Pozzi, Avv. A. Abbove, Ing. P. Tarantola, Ing. U. Zanella, and Prof. G. Corte Enna. The Company submitted that, for the normal working of a bench of eight arches of inclined retorts, twelve men per twenty-four hours, in shifts of eight hours, were sufficient; but if they were not enough, the Company left the number to be employed to the Arbitrators. The men, on the other hand, contended that the number of stokers formerly employed was the same now, though the amount of coal carbonized in the same retorts has been increased by one-third; and they argued that the number of men ought, therefore, to be increased by at least one-quarter—from eight to ten men per squad and per bench of eight beds. By a majority of the Arbitration Court, this demand of the men for an increase was rejected. They decided further that it was not necessary to retain the number of stokers actually employed; and, moreover, that, for all the labour involved in the working of the inclined retorts (excluding supervision of the hydraulic mains), the number of men could be reduced from eight to seven per squad per eight hours for each bench of eight arches —both at the San Celso works and at the new ones at Bovisa.

LONDON AND SOUTHERN JUNIOR ASSOCIATION.

A Meeting of the London and Southern District Junior Gas Association was held on Friday evening, at the Westminster Technical Institute, Vincent Square, S.W.—Mr. L. F. Tooth (the President) in the chair.

The Late Mr. Rothwell.

The President said he had, before they proceeded to the business of the meeting, one very regrettable announcement to make, and that was with reference to the sad loss which the Association had sustained through the death of Mr. Harry Rothwell. He was, as they all knew, a prominent member; and it would be difficult to fill his place. It had been decided that the vacancy on the Council which his death had caused should not be filled until the annual general meeting. He also regretted to tell the members that the circumstances in which Mr. Rothwell's family were left were extremely unfortunate; and the Council had decided to start a small fund, to which the members could subscribe in accordance with their means. They should remember the good services Mr. Rothwell had rendered to the Association, and do their utmost in this way to pay a tribute to his memory, and to acknowledge the work he had done. It was a most deserving case.

The Hon. Secretary (Mr. S. A. Carpenter) intimated that he would shortly be sending a circular out to the members asking them to contribute to the fund. Mr. Rothwell had really been a very hard-working member; and anything they could subscribe would be of great assistance to his wife and family.

Gas-Fires and Chimney Flues.

The President said he had much pleasure in introducing to the members Mr. E. W. Browning, the Inspector-in-Charge at the Westminster Office of the Gaslight and Coke Company, who had kindly consented to read a paper. This would certainly be of value to them.

Mr. Browning then read his paper, entitled "Gas-Fires and Chimney Flues," which, together with a report of the discussion, will be found on pp. 308-316.

The President, at the conclusion of the paper, said Mr. Browning must have gone to a great deal of trouble in its preparation; and the members were much indebted to him.

Mr. D. J. Winslow moved a hearty vote of thanks to the author—a proposal which was seconded by the Hon. Treasurer (Mr. J. Hewett), and carried with applause.

Mr. Browning, in acknowledging the vote, said it had afforded him great pleasure to come and give the Association what was really the boiled-down experience of a lifetime. He believed in finding out the cause of every difficulty before making any attempt to discover a remedy.

MIDLAND JUNIOR GAS ASSOCIATION.

Visit to Adderley Street Gas-Works, Birmingham.

The members of the Midland Junior Gas Engineering Association, to the number of sixty or more, paid an evening visit on Friday last, by permission of the Gas Committee, to the Adderley Street Works of the Birmingham Corporation Gas Department. The visitors were received by the Engineer of the Nechells and Adderley Street Works (Mr. W. Chaney) and the Works Superintendent (Mr. C. C. Barber), and were first of all conducted to a transformed "carpenters' shop," where tea—kindly provided by the Gas Committee—was partaken of. Apologies for absence were received from Mr. H. E. Copp, of West Bromwich, and Mr. B. W. Smith, of Walsall.

After these very much appreciated preliminary proceedings had been disposed of, the members made their way, under the guidance of the Engineer and the Superintendent, assisted by the Works Chemist (Mr. H. C. Smith), to the new retort-house. This house was fully described in the paper read by Mr. C. C. Barber before the Association some time ago ["Journal" for Dec. 14, 1909]. At that date, the plant had only recently been started up, and actual working results could not therefore be given by the author, who, however, estimated that they would be able to obtain well over 11,000 cubic feet of 16-candle gas (as tested by the No. 1 burner). This estimate has been more than fulfilled; Mr. Barber stating on Friday that their average yield from an ordinary slack coal was approximately 12,600 cubic feet per ton of 15¼-candle power (both uncorrected for carbonic acid). The productive capacity of the house is about 1¾ million cubic feet per day. There are two retort benches in one row, each consisting of eight beds of six horizontal retorts, and each retort being 25 in. by 15¼ in. ⌂ section and 20 feet long. The settings are Gibbons and Masters' patent "A.B.C." regenerative settings. The temperatures of the retorts were noticed to be high. They were said to be an average of about 1850° to 1900° Fahr.; the fuel used being about 12 per cent. The retorts are scurfed once every five or six weeks; and the fires are clinkered every 48 hours. The retorts are discharged and charged simultaneously by means of a Fiddes-Aldridge machine. The mechanism and action of this machine were fully described by Mr. Chaney; and the drawing and charging of the retorts were then watched—the evenness of the charge throughout the retort being commented upon. Asked whether the action of the charger had any deleterious effect upon the retort, Mr. Chaney stated that in his opinion the contrary was the case—the machine tending to preserve the shape of the retort. It was mentioned that at Adderley Street the best results were obtained with 9¾ cwt. charges of eight hours' duration. There is only one ascension-pipe, 8 inches in diameter, to each retort; and all are placed on the discharging side. The hydraulic main is divided into sections (one for each bed), and is supported on cast-iron saddles resting on joists connected to the buckstaves on both sides of the benches. There is a tar-tower for each retort-bench, connected to the hydraulic main by means of a 6-inch tar-main. A 10-inch Cort's weir-valve is fixed to each section of the hydraulic main; so that, in the event of either the tar main becoming blocked or the hydraulic main getting out of level, the seals on any section may be regulated independently of the tar-tower. It was stated that ½-inch seals were being worked with a pull of about 6-10ths. Retort-house governors are installed, but had been thrown out of action; Mr. Barber stating that he found satisfactory results could be obtained by means of an ordinary Parkinson governor in the exhauster-house. A novel feature was subsequently noticed in connection with this governor (which is coupled by means of a connecting-rod to the throttle-valve of the steam-engine driving twin exhausters, each of 50,000 cubic feet per hour capacity. In the centre of the connecting-rod, there is a running screw, by means of which easy adjustment of the speed of the exhausters can be made by the engine-driver, who was seen carefully observing his water-gauge and occasionally regulating the speed in this way. The excellent lighting of the retort-house was very noticeable. This has been accomplished by Hands' inverted incandescent lamps.

The coke is dealt with by means of a Telpher transporter (which has been installed by Messrs. Strachan and Henshaw, of Bristol) running through the retort-house, alongside the wharf, and across the canal—which runs through the works—to the coke-loading yard. There are two motors in the Telpher cab; one for hoisting, and one for travelling. These motors are respectively 37 amperes and 24 amperes, working at 220 volts. The coke is discharged from the retorts into cages, and is slightly quenched by hose-pipes. The cages, or skips, are then picked up the Telpher, taken to a tank of water and dipped, and then conveyed to where required in the yard—the skips being emptied by the man in the cab. The speed of the Telpher was stated to be about 600 feet per minute; Mr. Chaney saying that this, of course, was not fast enough to keep pace with the pusher, which could empty and charge a retort in half-a-minute. It is, however, working very satisfactorily and economically; and the coke obtained is much larger than would be possible with an ordinary conveyor. In fact, the only breeze made at Adderley Street is that due to the subsequent forking over of the coke-heaps.

The members were taken to the engine and dynamo house, where they admired the polished appearance of all the machinery. Indeed, the cleanly condition of the works generally was the subject of eulogistic comment, and reflects the greatest credit upon Mr. Barber, who assured the members that it was quite the usual condition, with perhaps a little extra sweeping-up in honour of the event. The engine-house contains, besides the twin steam exhausters by Messrs. George Waller and Son, already noted, two gas-engines and dynamos, the latter each capable of producing 36 kilowatts per hour. The coal crusher, elevator, and conveyor, besides the Fiddes-Aldridge machine and the Telpher, are all driven by electric motors. A Beasley recording calorimeter (made by Messrs. Parkinson and Cowan) was noticed in the exhauster-house. This was stated to be doing its work very well, and was giving satisfaction. The evenness of the calorific line was observed; the average being about 550 B.Th.U. Mr. Chaney remarked that with the Fiddes-Aldridge machine, though the illuminating power might drop to 13 or 14 candles, the calorific power was maintained.

It was too dark to see the plant in the open properly; but the condensers are of the battery type; and two Young's washers and a tower-scrubber are installed—the latter filled with boards. There are two sets of purifiers, each consisting of four boxes and two catch-boxes. After visiting the laboratory, where Dr. W. B. Davidson (who formed one of the party) showed the members round, the carpenters' shop was adjourned to.

The President (Mr. R. S. Ramsden, of Burton-on-Trent) proposed a hearty vote of thanks to the Birmingham Gas Committee for the excellent entertainment they had provided for the members. They also wished to thank Mr. Chaney and Mr. Barber, and their assistants, very much indeed for the instructive visit they had enjoyed. It had been particularly interesting to him, because at Burton-on-Trent they had also been putting up a new retort-house on the horizontal system—the same as adopted at Adderley Street. At Burton, however, they had installed the De Brouwer discharging and charging machine, and dealt with the coke by means of a De Brouwer conveyor. It seemed to him that each system had its peculiar advantages and its peculiar disadvantages; and it was, of course, a very difficult matter for juniors like themselves to decide which was the best.

Mr. A. O. Jones (West Bromwich) seconded the motion, and further expressed the members' indebtedness to Mr. Chaney for so kindly taking them round the works and making the visit as interesting as possible, and also to Mr. Barber and Mr. Smith for

the able way in which they had given the members all the information required.

Mr. F. J. Ward (Knowle) supported the motion. To him the visit had been a great source of instruction—more especially in the retort-house. He was amazed to see the method by which the charges were dealt with. At one time Adderley Street was regarded as a gas-works which was going to be demolished very quickly; but to judge by the state of affairs to-day, it was apparently in the front rank of the Birmingham works as regarded results. He was astonished at the extreme heat at which carbonization was carried on, with apparently the minimum of discomfort to the men.

After the resolution had been carried by acclamation,

Mr. Chaney, in response, stated that he would convey the vote of thanks to the Gas Committee; and on their behalf, he could assure the members the invitation for the visit had been extended with much pleasure, and that the Committee always looked forward to a "repeat order." He had no doubt the members would be pleased to oblige them in this respect later on. He was exceedingly pleased that he had been able to welcome them personally. As Mr. Ward had pointed out, Adderley Street was a very old works. The Gas Committee at one time were seriously considering the advisability of pulling down the works. But it was found, as Birmingham grew, that Adderley Street became the centre of a large distributing area; and though they were a long way from their coal (it cost them something like 1s. per ton to get the coal to the works by horse and cart) it was found much more economical to keep the works going, because during the first two hours of darkness they could put on the district all the gas they made in 24 hours, which was, of course, of great advantage in supplementing the supply from the larger stations. He gathered that the general opinion among the members was that very high heats were adopted at Adderley Street. There were two ways of getting a good make of gas. One was by "stretching" the gas, which, in other words, meant speeding up their exhauster. But the more legitimate way was by high temperature; and from his experience, less harm would be done in this way to the retorts than by over-pulling.

Mr. C. C. Barber also responded, and endorsed Mr. Chaney's remarks. He thought the results now obtained at Adderley Street amply justified the decision of the Committee to keep the works going. Their average make was 12,600 cubic feet per ton of 15·5-candle gas, with a calorific value of 540 B.Th.U. net. These results, he considered, justified their working high heats. The retorts had been working fifteen months; and the members would agree that they were still in splendid condition, having regard to the length of time they had been in operation.

SCOTTISH JUNIOR GAS ASSOCIATION.

WESTERN DISTRICT.

Visit to Messrs. Laidlaw's Meter Works.

On Saturday afternoon, the members of the Scottish Junior Gas Association—Western District—to the number of over eighty, travelled to Edinburgh, where they paid a visit to the gas-meter works of Messrs. R. Laidlaw and Son (Edinburgh), Limited. The party were received and welcomed by Mr. A. Young, the General Manager, and were shown over the works, in parties, by Mr. Young, Mr. G. Mills, their chief representative, Mr. S. Thomson, and Mr. A. Brown.

As is well known, the Company have for many years occupied premises in Simon Square, Edinburgh. The site is almost fully built upon; but, speaking generally, there are fewer works in the country which are better adapted for the work that is carried on in them. It is specially noticeable that in every department the utmost effort has been made to secure as much daylight as possible in the working rooms. Artificial light is wholly obtained by gas—incandescent gas-burners, upright and inverted, being fitted up on all the benches. The ventilation of the place is well attended to; which gives a sweetness to the atmosphere in rooms where a number of workpeople are employed, and adds greatly to their comfort. For the provision of power, there are two gas-engines, one 54 H.P. the other 24 H.P. The number of hands employed varies from about 250 to about 300.

The works were kept fully running for the benefit of the visitors, who consequently saw the whole of the processes in the making of meters of all sizes up to 150 lights, and the care with which they are tested. The mechanism of the prepayment meters, which are all fitted with the Colson cash-box, attracted much attention. In the foundry, the casting of articles in brass and aluminium was keenly scrutinized. The last item on the itinerary was a demonstration with the Rosie and M'Kelvie patent automatic controller for street-lamps—a device which works by pressure, and has never been known to fail in action.

At the close of the visit, the company were driven to Messrs. Ferguson and Forrester's restaurant in Princes Street, where tea was served.

Mr. A. Young, who presided, said that it had been a very great honour to the Company to have them visiting their works. The manufacture of gas-meters must appeal to all of them. He hoped they had learned something that would help them in their daily duties. As Mr. Thomas Wilson, of Coatbridge, had said at their annual meeting, the Association was practically a school for future gas engineers. This was what should be, because the position of gas manager was one of great responsibility. He also noticed that at the same meeting Mr. Alex. Wilson, of Glasgow, said there were strenuous times in store for gas, and that they would require to do their best to meet the competition. But he was quite certain they would be able to meet the competition. The best way to meet all competitors was simply to be thoroughly proficient in every part of the duties they had to do. They were fortunate in Glasgow in having such support as they got from men like Mr. Alex. Wilson, Mr. Thomas Wilson, and other managers. In designing the prepayment meter, he believed that most manufacturers looked upon a range of from 5 to 40 cubic feet for a penny as ample for all time coming. In his experience, they had never been asked to put on a change-wheel to give 40 cubic feet for a penny; but one gas company in Scotland were now proposing to do so. Mr. Thomas Wilson told him that his Company were giving 40 cubic feet of gas for a penny through prepayment meters. He thought this was a record. He hoped they noticed that in their works they used as much coal gas as possible. His belief was that, seeing they were practically supported by the gas industry and those connected with it, they should, in turn, support them, and he had tried, as long as he had had to do with the management of the works, to use coal gas for every possible thing he could. Last year they consumed nearly 6,000,000 cubic feet of gas in their works. He would like, if they could, to consume more. His idea was that they might be able to melt all their metal by coal gas. He was pleased to observe that in Birmingham they could melt a ton of brass for 8s. 6d. This was a very low figure, indeed; and when they in Edinburgh could do this, they would be able to supply meters cheaper. Some time ago, a speaker at a Junior Gas Association meeting in the South mentioned that he melted brass at 11s. 8d. per ton. In their works, using gas coke, they estimated it cost them 2d. per lb.—nearly 18s. 8d. per ton. If they could introduce gas for melting, and obtained such favourable results, it would be an advantage to them. He hoped this would not be the last visit of the Association to their works, and that when they came again they would find that the Company were using, not 6,000,000 but at least 10,000,000 cubic feet of gas a year.

The President (Mr. J. Frazer, of Provan), on behalf of the Association, thanked Messrs. Laidlaw for allowing them the privilege of visiting their magnificent works. Everyone whom he had spoken to was thoroughly satisfied with what he had seen. They would all go back to Glasgow wiser than when they arrived. This had been looked forward to by the members of the Association as being the visit of the session. The visit, he might say, had been got up for the purpose of letting the members of the Association who were employed in the Walls Street shops in Glasgow have an opportunity of seeing meters in the making; and he was sure they had seen the process of meter-making reduced, he might say, to a fine art. The prepayment meter occupied a very large place in Messrs. Laidlaw's works. As they knew, the prepayment meter occupied to-day quite a different position in the minds of gas managers from what it did (say) twenty years ago. It gave to the gas manager an outlet for gas which he never had before.

Mr. Thomas Wilson (Coatbridge) endorsed the remarks of the President. They had seen works in which were all the latest improvements in the manufacture of the modern gas-meter. He had been complimenting Mr. Young on the improvements which had been carried out in the mechanism of the dry meter. If they wished to be successful in their business, they must have modern instruments for the measurement of their gas. He might tell them that at Coatbridge they were in the unique position of having sold 57,000 cubic feet more gas than they had made. This was a fact; and he might say that they had been at a loss to know how to put it in the balance-sheet.

Mr. W. Ewing (Lochgelly) also endorsed everything which previous speakers had said. As an old employee of the Company, he had the highest respect for them. Their manufactures were known all over the world; and they had shown them some things that day which they might say were perfect. He proposed the health of Messrs. Laidlaw and Son.

Mr. Young having returned thanks,

Mr. G. Mills, the Chief Representative of the Company, also acknowledged the toast. He advocated more vigorous methods in the sale of gas. In Scotland, they had very absurd systems of working in regard to the changing of meters. He understood that in Edinburgh they had something like 14,000 removals, and that in every case a meter had to be brought into store and put out again. This led to a great amount of expense, and expense which he thought might be avoided. The same thing applied to gas-cookers. Some years ago, he spoke to the late Mr. William Foulis on the subject, and suggested a scheme for the remedying of the evil. He did not know how many cookers were now brought in in Glasgow; but it must be a tremendous number. He suggested that a staff of men should be employed who would endeavour to get incoming tenants to take over the gas-stoves and so save the expense of removal. He sometimes thought that in their Associations they devoted rather too much time to the technical side of the industry, and that it would be a good thing if they were to endeavour to get more knowledge of the business side of it—that every effort should be made to sell the gas they took so much trouble to produce. He was surprised to learn of an appointment of a gas manager for a town in England, in connection with which one of the candidates, he believed, offered to take the position at

£100 a year less than it was advertised at. A man who would do this would not be of much good to himself or anybody else.

A number of songs, contributed by the company, led to a very pleasant evening being spent.

INDUSTRIAL PYROMETRY.

We continue our notice of the series of Cantor Lectures on the above subject recently delivered by Mr. Charles R. Darling before the Society of Arts.

Mr. Darling's third lecture was devoted to the subject of resistance pyrometers. He explained that when a wire composed of a single metal is heated, the resistance offered to the passage of a current of electricity is increased; and this augmentation of resistance continues as the temperature rises. Certain alloys, however, are practically unchanged in resistance when heated; and some actually show a diminution—a property shared by carbon, which permits the electric current to pass more freely when hot than when cold. Consequently, the greatest increase in resistance is manifested by pure metals; and this fact furnishes a guide in applying the phenomenon to the measurement of high temperatures. The first pyrometer based on this property of pure metals was devised by Sir William Siemens in 1871; and with the instrument a table was provided from which the temperature could be read off—the value for known resistances given in the table having been determined by comparison with the gas scale. Some of these pyrometers are still in use.

The most concise method of measuring resistances, however, is furnished by the arrangement known as "Wheatstone's Bridge." This was adopted in the later forms of Siemens pyrometers, and is now generally employed by other makers. The present success of the resistance pyrometer, however, is largely due to the researches of Callendar and Griffiths, who proved that, under proper conditions, the instrument could be made to give concordant readings, and was susceptible of a far greater degree of accuracy than the thermo-electric method. By careful comparison with the gas scale, these observers proved that the relation between the resistance of platinum and its temperature could be expressed by a formula which, over a wide range, would not lead to a greater error than 0·1° C.

The lecturer next considered the possibilities of the resistance method with respect to the limits of accuracy; and having arrived at a correct method of calibration, he proceeded to examine the practical forms of instruments used at the present time. In the resistance pyrometers made by the Cambridge Scientific Instrument Company, the platinum wire is wound on a mica frame, and is connected by leads to a pair of terminals at the head. As these leads would alter in resistance on heating, a pair of exactly similar leads are also inserted, connected to another pair of terminals at the head; and they are made to oppose the ordinary leads in the measuring arrangement, whereby the altering resistance of the pyrometer leads is rendered inoperative. The platinum is protected from furnace gases by surrounding the coil and leads with a porcelain tube. In the Siemens resistance pyrometer, the wire is wound on a special fire-clay, and is preserved from damage by being surrounded with magnesia and encased in an iron tube; a single compensating lead being employed, joined up in the measuring device so as to cancel the variation in the ordinary leads. In America, the Leeds-Northrup Company wind the platinum upon lava instead of mica, and in some cases use a differential galvanometer method to measure the resistance.

In industrial practice, it is necessary that direct temperature readings on the gas scale should be obtained on the indicator; and in modern instruments this end is achieved in various ways, which the lecturer explained in detail. He then passed on to examine the possibilities of the finished instrument. He showed that the limit of temperature at which a resistance pyrometer may be continuously used is 1000° C. If this be exceeded for any length of time, the resistance of the platinum is permanently altered, and the readings are thereby rendered erroneous. Below 1000° C., however, it is possible to secure a more exact reading than can be obtained by the thermo-electric method. But this advantage is more apparent than real. In most cases it is not possible to control the temperature of a furnace to within less than 5° C.; and in such instances no advantage is secured by attempting to read to 1° C. Under special circumstances, where a high degree of accuracy is procurable and desirable, the resistance pyrometer is unrivalled for temperatures below 1000° C. There are no errors to creep in analogous to those arising from alterations in the temperature of the cold junction of a thermo-electric pyrometer; and leads of any length may be used, provided the compensating leads are identical. On the other hand, the indications are not automatic, nor can the principle be easily applied to making an installation worked from a central office, owing to the difficulty of having each pyrometer of exactly equal resistance. In addition, the cost is greater than that of a thermo-electric outfit, and repairs are more difficult to execute. Hence the tendency is to employ the resistance pyrometer for very accurate work at moderately high temperatures, under conditions which demand a precision not to be obtained by the thermo-electric method. The lecturer showed by the aid of slides several examples of the successful employment of resistance pyrometers in the hot-air mains of blast-furnaces, biscuit-kilns for pottery, and annealing and tempering furnaces for the treatment of steel.

The first successful recorder for use with a resistance pyrometer was devised by Professor Callendar. In principle, it consists of an arrangement by which the adjusting resistance in a Wheatstone bridge circuit is automatically made to equal that of the pyrometer by the movement of a slider over the resistance; a pen being carried by the sliding-piece which marks a graduated paper. The only part of a Wheatstone bridge circuit which moves when the resistances are not adjusted is the galvanometer; and when the resistance introduced is greater than that being measured, the moving part of the galvanometer turns in one direction, and when less in the opposite direction. In Callendar's recorder, a moving-coil galvanometer is used; and a boom attached to the coil is made to complete an electric circuit when the coil twists to the right, and another circuit when the coil turns to the left. The result in either case is to set in motion mechanism which moves the slider along the resistance opposed to the pyrometer; the movement being to right or left according to the direction in which the galvanometer boom has moved, as the two mechanisms actuate the slider in opposite directions. When a balance is restored, the galvanometer boom will take up a central position, free of both contacts, and the sliding-piece will then be at rest. The paper in contact with the pen is wound on a drum, and made to rotate at a known rate by internal clockwork. If the slider carrying the pen remained at rest, a straight line would be traced on the paper, while movements due to fluctuations of temperature (and therefore of resistance) in the pyrometer will cause the pen to move to the right or left—thus drawing a sinuous line on the chart from which the temperature at any time may be deduced. The Callendar recorder contains, of necessity, mechanism of a delicate character, and requires careful handling. The galvanometer boom has to be relied upon to make a certain contact so as to complete the circuit which actuates the mechanisms. But the force with which the boom is pressed against the contact surface is very small indeed; being due to the axial twist of the coil to which the boom is attached. Dr. Northrup, of Philadelphia, has recently designed a recorder in which this difficulty is overcome. In it a differential galvanometer is used in preference to a Wheatstone bridge arrangement; but the lecturer said certain incidental difficulties remain to be overcome before the instrument is available for commercial use.

The lecturer concluded by saying that, in the hands of modern instrument makers, the resistance pyrometer, like the thermo-electric one, has been converted from a crude and an unreliable instrument to one of great utility and accuracy. He pointed out, however, that all pyrometers which are kept permanently at high temperatures, and especially at any point above 1000° C., undergo deterioration in course of time. Even for occasional readings, when specially made for the purpose, the highest reading obtainable is the melting-point of platinum, which is 1753° C.—a temperature often exceeded in modern industrial operations. He thought it would be an advantage if correct readings could be secured by means of an instrument of which no part need be placed in the furnace, and which would be capable of measuring more exalted temperatures than is possible when pyrometers of the types he had described are used. Fortunately, modern scientific discoveries had, he said, enabled such instruments to be placed at our disposal.

In his concluding lecture, Mr. Darling dealt further with radiation pyrometers. He reminded his audience that in his first lecture (*ante*, p. 40) it was remarked that Newton, in 1701, made an attempt to measure the temperature of a coal fire by a method depending upon the rate at which an iron bar drawn from the fire radiated energy to its surroundings. In the last century, many observers, taking advantage of Nobili's thermopile, endeavoured to determine a relation between the energy falling upon it and the temperature of the radiating source. Among those who worked in this direction was Tyndall, who recorded a number of results obtained by allowing the radiations from a platinum surface heated to different temperatures to fall on a thermopile; the deflection of the needle of the galvanometer in the circuit being noted for each temperature. These figures were neglected for many years; but in 1879, Herr Stefan, of Vienna, on submitting them to a close examination, came to the conclusion that the energy radiated by the hot platinum varied as the fourth power of the absolute temperature. He expressed the opinion that all solid bodies radiate energy according to this law, under certain attainable conditions of surface—a conclusion which has proved to be erroneous.

In the year 1884, Boltzmann published a mathematical investigation of this subject, based on thermodynamic reasoning; and he arrived at the same result as Stefan—viz., that the energy radiated by a hot substance varies as the fourth power of the absolute temperature, provided—and herein lay the clarifying effect of Boltzmann's investigation—that the surface behaved as a perfect radiator of energy. The lecturer said he did not propose to give the details of this valuable contribution to scientific knowledge. It was sufficient to say that two assumptions made in the investigation—viz., the existence of light pressure and the composition of the spectrum of radiation when changing in density—were afterwards proved to be justifiable by Lebedew and Wein. We at the present day, therefore, were not, he said, dealing with an empirical law, but with one capable of mathematical proof; and we might therefore apply this law with confidence in all cases where the condition of perfect radiation is realized.

If, however, no known surface acts as a perfect radiator, the

question at once arises as to how it is possible to apply the fourth-power law in practice so as to measure temperatures. To answer this question, it was necessary to refer to the work of Kirchoff, who in 1860 pointed out that an enclosure, at a constant temperature throughout, would emit radiations through a small aperture in one side to exactly the same extent as would a perfect surface at the same temperature. Such an arrangement was termed by Kirchoff a "black body"—not that it was necessarily black in colour, but because it conformed to the general idea of absolute blackness in the sense of total absorption of radiations. The value of this in relation to pyrometry arises from the fact that almost all operations at high temperatures are conducted in enclosures called furnaces; and radiations from the interior of a furnace through a small opening in the side are true black-body radiations. It fortunately happens, therefore, that the very condition necessary to render the fourth-power law valid in practice is realized in almost all industrial processes.

The first pyrometer constructed on these lines was devised by M. Féry, of Paris, in 1902. It consisted of a kind of telescope, the object glass of which focussed the rays from the hot source on a tiny thermal junction, after the fashion of a burning-lens. The thermal junction was coupled up with a delicate galvanometer, which by its deflections measured the relative quantities of energy falling on the junction under varying conditions. By taking one accurate reading of a furnace kept at a known temperature, the whole scale of the galvanometer could be divided so as to read in temperatures directly. M. Féry's pyrometer suffered from a grave defect which prevented a strict application of the radiation law to its readings. A large proportion of the radiant energy from a heated source cannot pass through glass; and though this difficulty might be overcome by the use of a fluorspar lens in place of the glass objective, the cost of such a lens would militate against the use of the instrument for industrial purposes. In 1904, however, Féry solved the problem by using a concave mirror to focus the radiations on the junction. "The history of the evolution of the Féry pyrometer," said the lecturer, "furnishes one of the most striking examples of the manner in which a number of discoveries may be blended into a most useful instrument. Eight great names are inseparably connected with this device. The sighting telescope recalls Galileo; the concave mirror for bringing the rays to a focus in this form takes us back to Newton; the thermal junction was the discovery of Seebeck; the moving-coil galvanometer originated with d'Arsonval; and the fourth-power temperature scale enshrines the names of Kirchoff, Tyndall, Stefan, and Boltzmann. And, in all justice, we should add as a ninth name that of Féry, who so ingeniously combined the work of his predecessors." The lecturer then passed on to consider the industrial uses of this pyrometer, and pointed out that care should always be taken to employ it under "black body" conditions, either by sighting the object while still in the furnace or on the end of a closed tube inserted with the end in contact with the source of heat.

The latest development of radiation pyrometers is due to Foster, who has designed an instrument which, within reasonable working limits, gives a correct reading without requiring to be focussed. As in the Féry pyrometer, a galvanometer graduated in accordance with the fourth-power law is used; and records can similarly be secured with a thermo-electric recorder.

The pyrometers previously considered by the lecturer were all based upon the law governing the total energy radiated. He showed, however, that there is another class of instruments in which an individual ray, selected from the visible part of the spectrum, is made, by its intensity, to give a clue to the temperature of the source. The visible spectrum, obtained when rays from an incandescent source are passed through a prism, represents only a portion of the sifted energy. Beyond the violet end may be traced shorter waves, which darken a sensitized paper; and beyond the red are to be found longer waves, which are best detected by absorbing them on a dull, black surface, when they become manifest as heat. The quantitative examination of the spectrum was first undertaken by Tyndall in 1863 by means of the thermopile, which, with its blackened face, converted almost all the rays falling upon it, both visible and invisible, into heat; and by noting the deflection of the galvanometer when the thermopile was placed in different parts of the spectrum, the energy represented by different wave-lengths was discovered. Langley, by the aid of the bolometer—an instrument far more sensitive than the thermopile, and working on the same principle as the resistance pyrometer—was able to map the distribution of energy in the spectrum more accurately than Tyndall; and the combined work of many physicists has resulted in several important generalizations, which have proved of great service in measurements of temperature. The conclusion from these investigations is that the intensity of a portion of the visible spectrum may be employed give correct readings of the highest temperatures attainable.

Of the several varieties of instrument available, Mr. Darling selected for detailed description the Holborn-Kurlbaum optical pyrometer; this being, he said, the simplest, both in construction and use. It consists of a telescope, in the focal plane of which is placed an electric lamp, furnished with a carbon filament of hair-pin shape. In series with this lamp is a battery, a rheostat, and a milliammeter, which records the current passing through the lamp. In front of the eye-piece of the telescope, two pieces of red glass are placed; and on looking into the telescope, a red field, due to the heated object, is seen, upon which the filament of the lamp is superposed. The adjustment consists in altering the resistance until the filament is brought to the same brightness as the surrounding field, when the current indicated by the milliammeter is read. The lecturer said it would be a somewhat tedious matter to show how readings of current might be translated into temperatures by the aid of Wein's law (which he had previously explained); and therefore it must suffice to state that a table might be calculated from which temperatures corresponding to milliamperes might be read off. If the temperature of the source exceeded that of the lamp at maximum current, the absorbing device, consisting of two mirrors of dark glass, was placed on the end of the telescope, so that the brightness of the source was reduced below that of the lamp at full current. A second temperature scale was prepared for use with the instrument when the absorber was employed; and indefinitely high readings could be obtained. One of the advantages of this pyrometer was the ease and certainty of the adjustment. He here mentioned that the masterly researches of Waidner and Burgess at the United States Bureau of Standards during the past few years, on the highest attainable temperatures, had been conducted by the aid of this instrument. It was made in two forms—one being mounted on a tripod stand for use in a fixed position; while the other was made so as to be portable. This pyrometer was of great service for temperatures exceeding 1200° C. (2200° Fahr.), and might be used with equal advantage for lower readings. It could not, however, be adapted to the taking of records—a defect common to all optical pyrometers.

Turning to the forms of optical pyrometer which require in the adjustment the equalizing of the colours of two fields—one due to the standard and the other to the source—or the production of a special tint, the lecturer remarked that in the Wanner pyrometer, red rays from the source and standard are obtained by means of prisms—thus securing monochromatic light, and are brought to equal brightness by a polarizing device; while in Féry's optical pyrometer, rays from the source are passed through two wedges of darkened glass, which are capable of sliding over each other, and are moved until the source is reduced to the same brightness as the standard. Both are capable of calibration by Wein's law. In the Mesuré and Nouel pyrometer, which is a polarizing arrangement, the relative brightness of the red and green portions of the spectrum is the principle relied upon; and the adjustment consists in producing a neutral yellow tint by rotating an analyzer. The calibration in this case is empirical.

In bringing his interesting lectures to a close, Mr. Darling expressed the hope that they had made evident the great industrial importance of pyrometry, and would assist in producing an increased appreciation of the value of high-temperature measurements. It would have been gathered, he said, that each type possesses advantages peculiar to itself; and he emphasized the point that the choice of an instrument should be preceded by careful consideration of its suitability for the purpose intended.

Samuel Cutler and Sons.

The announcement is made that this long established firm has just been converted into a private Limited Company, and will henceforth be known under the style and title of Samuel Cutler and Sons, Limited, of Providence Iron-Works, Millwall, and of No. 39, Victoria Street, Westminster, S.W. The change has been arranged solely for private and family reasons; the whole of the share and debenture capital being provided by the partners. The present issue consists of £98,000—made up of £40,000 of 5½ per cent. cumulative preference shares, £30,000 of ordinary shares, and £28,000 of 5 per cent. debentures. The business will be in future carried on under the same management and auspices as hitherto, which has resulted in such a world-wide and desirable reputation. The Directors are Mr. Samuel Cutler, who is Chairman, with Mr. George B. Cutler and Mr. Samuel Cutler, jun., as his colleagues. Mr. Ernest E. Cutler will be the Secretary.

The Projected "Coronation Exhibition."

Mr. D. Milne Watson, the General Manager of the Gaslight and Coke Company, has addressed a circular-letter on the above subject to all the gas companies within fifty miles of London. He says that, in view of the large number of visitors likely to be in London during the summer, there is every prospect that such an exhibition would be an even greater success than that of last year. As a preliminary step, the same site has been secured at a reduced rental; and it is suggested that the gas industry should organize an exhibit there. The stand containing last year's exhibit is still intact; and this the Committee of last year have kindly agreed to hand over, without charge, to any responsible new Committee which may be formed. This would enable the exhibit to be started in a very favourable financial position; and it is hoped, therefore, that the industry will co-operate to make the show a really good one. Lest it should be thought that such an exhibit benefits Metropolitan and Suburban Gas Companies only, Mr. Milne Watson explains that last year nearly 400 different gas undertakings were communicated with by the Committee's officials in reference to inquiries made by the very large number of visitors to the stand; and the result amply repaid the trouble and expense involved in the joint exhibit. It is proposed to hold this (Tuesday) afternoon a meeting at the Gaslight and Coke Company's chief offices, in the Horseferry Road, Westminster, to consider the subject.

GAS FIRES AND CHIMNEY FLUES.

By E. W. Browning, of the Gaslight and Coke Company.

[A Paper read before the London and Southern District Junior Gas Association, Jan. 27.]

There is no more important question connected with the gas industry than that of pushing and promoting the use of gas-fires. So much prejudice has existed in the past in connection with this great business, that it is the duty of every gas-man to make himself thoroughly acquainted with all that can be said for and against gas-fires. In years gone by, when there was little or no opposition to our industry, and when gas held its own for lighting purposes, when gas companies had not felt the necessity for pushing this branch of the business, and when the construction and manufacture of gas-fires was in its infancy, it was probably not so essential for a man to possess this knowledge as it is at the present day, when gas has to compete for all purposes, not only with an active oil trade, but with that great fighting competitor—electricity. Cooking by gas is now so universally popular that one has not very seriously to consider the question of its advocacy. All classes—from the artizan in Battersea to the occupier of the mansion in Park Lane, from the small business house in Lambeth to the largest industrial concern in London, from the workman's club in Soho or Bethnal Green to the palatial establishment in Pall Mall, from the humble but useful coffee shop or refreshment-room in Whitechapel or elsewhere to the gigantic hotel in the West-end of London, from the fireman's residential chambers erected under the auspices of the London County Council to the King's Palace in St. James's Park—in fact, in all sections of society it is recognized that gas for cooking is economical, efficient, labour-saving, and, in a word, essential. Prejudice has been practically conquered by experience; and personal convenience has demonstrated the absolute necessity for the gas-cooker.

Some Investigations Recalled.

But while it is a fact that the advantages of gas as a fuel used for cooking purposes are now recognized almost universally, much remains to be done to remove from the public mind the prejudices—which I am sorry to say still exist in some quarters—against the use of gas-fires, although these prejudices have been greatly reduced in recent years, largely owing to the interest taken by some few scientific men concerned in the question of smoke abatement, as well as to the improvements made in gas-fire construction and the more active policy adopted by gas companies in recent years in advertising the advantages of gas for heating. Of such vital importance was this question considered from the public health point of view, that in the year 1892 the "Lancet" appointed a Special Analytical Sanitary Commission to deal with the question of the uses of gaseous fuel and gas heating appliances; and it was my privilege and pleasure to have been very closely associated with that inquiry.

At that period, electricity had not attained the position that it occupies to-day; and the sale of gas for heating purposes was not considered so absolutely essential to the prosperity of the gas industry as now. The science of using gas instead of coal for heating purposes had been passing through its infancy; and during the earlier years of gas-fires, some were perfectly gluttonous in regard to their consumption of gas—burning from 70 to 80, and more, cubic feet of gas per hour, without giving satisfactory heating results. It was, further, a common practice for private gas-fitters to recommend and fix gas-fires in grates, because coal could not be used on account of smoky chimneys. However, I think it may safely be asserted that about the year 1892 the gas-fire industry had passed through its infancy, and had attained its youth. Apart from the question of economy in consumption, which was not then considered a prime factor, there were some fairly good stoves on the market at that period, reasonably efficient in their construction from a health point of view; and some of them came through the ordeal of the "Lancet" scientific investigation with gratifying success.

Fourteen gas-fires of various makes and types were carefully selected and submitted for test. They were of three types—viz., ball fuel, asbestos fibre, and iron trellis, and were tested under maximum and minimum pressures, ranging from 14-10ths to 21-10ths. In their report, the Commissioners stated that "in no single instance could incomplete or imperfect products of combustion be found in the gases going up the chimney; in other words, the permanent gases from the flue consisted wholly of carbonic acid, nitrogen, and oxygen. That most minute tests failed to find any deleterious products in the air of the room, in spite of the fact that no special precautions were taken to ensure ventilation." Two defects were specified—viz., roaring at high pressure, and lighting-back at low pressure—and it was given as the opinion of Mr. Vasey (Chemical Analyst of the "Lancet," and one of the Commissioners) that the lighting-back of atmospheric burners—due either to a down-draught or to the too low pressure at which a fire was worked—was the cause of considerable prejudice through incomplete combustion—which blackened the fuel with soot—and the production of offensive acetylene, which diffused a most obnoxious smell in the room; and he expressed the opinion that the production of this offensive acetylene could be obviated by "strict attention on the part of the manufacturers to the proper adjustment of the burner," and on the part of the consumer "to the regulation of the gas supply by allowing sufficient pressure to act upon the burner and by occasional cleaning of the burner." He also pointed out that "governors or regulators fitted to each burner, if there are separate taps, obviate the necessity of regulating the main pressure and give perhaps the most satisfactory result," although he had "noticed a tendency in the flames of burners provided with governors to become in part and gradually luminous." Another point he emphasized was that "the fuel should be packed well, as too great an interference with the normal flow of the flames tended to the production of unburnt gases, as well as the emission of combustion products into the air." He also entertained a preference for gas-fires which gave radiated heat only; and while admitting that "the greatest calorific effect is gained by fires which gave convected heat," he stated that it was "well known that air so heated lost some of its essential properties," for "air scorched is apt to impart a disagreeable smell in the room, arising from the burning of dust particles," and that the "drying effect experienced in some gas-fires was due to an unreasonable overheating of the room." Finally, he affirmed that "gas could be efficiently used for warming purposes without prejudice to health, and the formation of fog-forming constituents or air-contaminating products;" but he held very strongly that "each fire should be constructed with an efficient flue."

The principles laid down by the "Lancet" Commissioners were studied by manufacturers; and continuous efforts were made by them to improve the construction of gas-fires. But I do not think that any very rapid progress was made, so far as their scientific construction was concerned. I believe a great deal was left to chance. One maker brought out a new pattern fire, and immediately other makers copied the design. It would be interesting to know, however, whether they subjected these fires to any severe tests. No very great originality in design or practical improvement was attained for many years. The old lines of construction, it appeared, were invariably followed. There were, however, some exceptions which I need not here dilate on.

So matters went on until the year 1906, when the Coal Smoke Abatement Society took up the question in connection with the Royal Sanitary Institute, which resulted in the celebrated series of experiments conducted by Dr. John S. Owen on the premises of the New Government Offices in Parliament Street; and I had the honour of being associated in that investigation. The chimney-flues were 68 feet long and 9 inches in diameter, and were constructed of glazed pipes. The opening of each chimney-flue at the top of the fire-place recess was filled in with strong sheet iron and made air-tight; the flue-pipe from each fire being allowed to pass through an opening in this sheet-iron plate, so that no heat or air could escape from the room except through the flue of the gas-fire. Test tubes with cocks attached were inserted in the flue-pipes. The door to each room could not be absolutely closed, but was left open ½ inch in each case for ventilation and air supply for the fire. It was found that the lowest pressure at which the various fires tested would become satisfactorily incandescent was 12-10ths. The fires were all adjusted to work at this pressure; and no departure from this arrangement was allowed.

I do not propose to go into the question of Dr. Owen's report—it can be read by any person who will purchase a copy of the "Lancet" dated Nov. 17, 1906; but it is satisfactory to know that it demonstrated the absolute healthiness, efficiency, and practical utility of properly-constructed gas-fires. It may not be out of place if I here quote some of Dr. Owen's conclusions, as the result of his most exhaustive tests. He affirmed that a "properly constructed gas-stove with a flue sufficiently large to carry away the products of combustion" (mark this point well) "is quite as satisfactory from a hygienic point of view as is a coal-fire, and does not in any way vitiate the air of the room, nor does it produce any abnormal drying effect as is popularly supposed. It will carry off from about 2000 to 4000 cubic feet of air per hour; and this is a valuable ventilating effect." He also pointed out that, "while gas-fires usually produced a fairly steady temperature in the rooms in from one to two hours, coal-fires took much longer." Another thing he asserted in favour of gas-fires was that "they could be easily regulated, and the heat of the room controlled in a way which was not possible with coal-fires." He was further of opinion "that a properly constructed gas-fire had the advantage of a coal-fire from a hygienic point of view, owing to more equal temperature and to absence of dust and smoke."

Dr. Samuel Rideal, a great authority on combustion, stated in his lecture at the Royal Sanitary Institute in December, 1908, that "the products of combustion from a coal-fire in an open grate were usually laden with black soot, smoke, and poisonous gases—viz., sulphuretted hydrogen and carbon monoxide; and that in gas-fires (even of the early type) sulphuretted hydrogen was never found, the combustion being more perfect." The "Lancet" Commission in 1892-3, and the experiments by Dr. Owen and his assistants in 1906, proved that "monoxide of carbon was never found in the flues of properly constructed gas-fires;" and at a meeting of the Leeds University held last November, in connection with the Gas Heating Research Committee's work, Professor Cohen stated that he had tested gas-fires, and did not find any carbonic oxide passing into the room from a gas-fire, nor could he detect any carbonic oxide passing into the flue.

Given a properly, and, as Dr. Owen calls it, "intelligently constructed" gas-fire, the next thing is to see that it is properly fitted to a good flue; and my personal experience has proved that the action of the chimney-flue is a very important factor in the question, if satisfaction is to be given. One important point to remember is the fact proved by Dr. Owen—viz., "that wind had

little or no effect in increasing the draught of a stove, although it was most effective in producing a draught in a chimney-flue which had no stove." His experiments demonstrated the strong influence exerted on chimney-flues by wind force. He also found that "the velocity of the current varied with the force of the wind." Another fact he ascertained was that "the velocity in the chimney-flue went on gradually increasing for about 1½ to 2 hours after the fire was lighted, after which it was fairly steady, and increased but slowly." However, since Dr. Owen's tests were made, there have been valuable investigations carried out by Mr. E. W. Smith in connection with the Gas Heating Research Committee's work at the Leeds University, which confirm previous investigations and break new ground. It is unnecessary for me to quote the results of Mr. Smith's work. You all read in the Technical Press the report which was presented to the meeting of the Institution of Gas Engineers last June, and the interesting discussion which followed. We have only to look around at the various new types of stoves in our show-rooms to see what great strides in design and efficiency have been made during the last three or four years. At the present time, gas-fires stand at a very high state of efficiency indeed.

An Adjustable Flue-Elbow.

A certain make of gas-stove with an adjustable flue-outlet has recently been placed on the market. In this type of stove, the products of combustion escape directly into the flue-pipes; there being no obstruction to their progress from the fuel through the canopy to the flue of the stove. This stove is designed to give radiant heat, which, it is well understood, is certainly the ideal heat to aim at. As Mr. Smith said at a meeting at the Leeds University in November last, "though radiant heat was the better heat to encourage in gas-fire work, is was not the total efficiency of the fire—there was also the convected heat from the sides and casing of the fire." One distinct advantage this fire had was that the direct escape of the hot flue gases into the chimney made the task of dealing with down-draught or a chimney having no natural upward draught, more easy. There was, however, at first considerable difficulty experienced in fixing these stoves—a special flue-elbow having to be made in almost every separate case; and owing to the various types of coal-grates to contend with, the necessity arose for an adjustable flue elbow. A Committee, of which I am Chairman, discussed this matter; and a friend of mine—Mr. E. C. Holt—suggested the possibility of obtaining an adjustable flue-elbow. Mr. William Fagan, another friend of mine, a man who has had more experience of gas-stoves than any other I know, was present; and subsequently he took up the matter with a certain firm, with the result that a very useful one was designed and brought out. I have pleasure in submitting a sample for inspection—another proof that "Necessity is the Mother of Invention." I think it will readily be admitted that the arrangement is a very decided improvement in flue-elbow construction; and I believe that the manufacturers have patented it. We must really agree that the stove referred to and the adjustable flue-elbow is a great advance in gas-stove construction, though it would appear that a great deal of heat which escapes up the chimney might be, I think, conserved and used to warm our rooms with advantage. I believe still greater progress in gas-fire construction is yet to follow.

The Question of Down-Draught.

Mr. J. H. Brearley, in a letter to the "Lancet," in February, 1907, wrote: "Anyone who understands the subject knows that, with a stove of approved construction and properly fixed, the products cannot enter the room unless the flue [meaning the chimney-flue] is deficient;" and my own personal and practical experience confirms the absolute truth of this statement. One of the first questions that a man should ask when arranging to fix a gas-fire is, Has the chimney ever smoked? If the answer is in the affirmative, he should endeavour to ascertain under what conditions it has smoked, and more especially the direction of the wind or the condition of the atmosphere at the time. If he is informed that the fire smoked when there was no wind, but during the existence of a depression in the atmosphere—viz., in still, cold, dull weather—he may assume that during these conditions the chimney has no natural upward pull; and he must therefore endeavour to create one, which he can do by lengthening the flue-pipe attached to the stove. Unless the products of combustion escape from the outlet of the flue-pipe with sufficient force to move the air in the chimney in an upward direction immediately the stove is lighted (and the weight of this air varies according to the length of the chimney and the density of the atmosphere), the products of combustion will escape from under the canopy of the stove. If, on the other hand, he is informed that the coal-fire smoked in gusty windy weather, he may safely assume that it is due to down-draught, and it will then be well for him to ascertain the direction of the wind at the time complained of. He should next make an examination of the surrounding chimney-tops and buildings. In many cases it will be found that the down-draught is due to neighbouring buildings being higher than the building which contains the chimney complained of, and that at certain times the wind will blow over these taller chimneys and down the chimneys of the lower building.

I have had to deal with a large number of flues of both kinds; and in the former case I have usually found that filling in the register or front of the grate with sheet iron and lengthening the flue-pipe on the stove will cure the defect. In a few cases it may not be necessary to fill in the register, though I always prefer to do so; for it may happen that the weight of air in the chimney—under exceptional circumstances—will force the products downwards, and they will be driven out into the room from under the breast of the chimney-piece (as in Diagram No. 1).

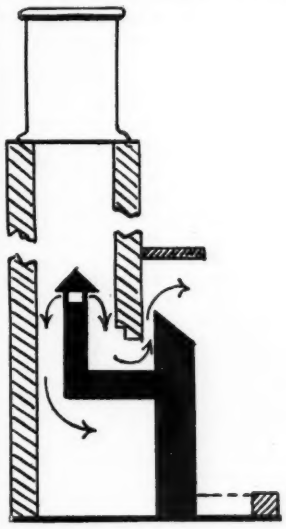


Diagram No. 1.

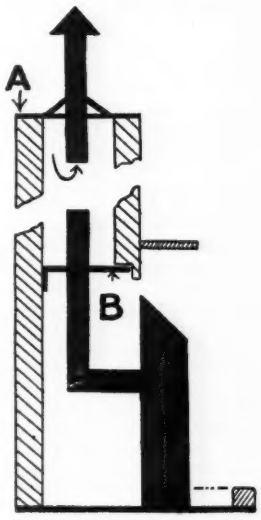


Diagram No. 2.

In the case of down-draught, I have found the following plan to be most successful. On the top of the chimney I fix a sheet-iron cap with a hole in it (see A, Diagram No. 2); and through this hole I insert a length of flue-pipe, 2 feet of which projects above the cap, and from 2 to 4 feet down the chimney—according to the length of the chimney and the difficulties to be overcome. A cone is fitted on the top of the flue-pipe. This arrangement is made in galvanized sheet iron, and will only cost from 5s. to 12s., according to the shape of the chimney-pot to which it has to be fitted. The front of the grate or register of the stove (whichever may be best under the circumstances of the case) is then filled in with sheet iron (see B, Diagram No. 2), and the flue-pipe is then carried through same and up the chimney. It must be of sufficient length to enable the velocity of the products of combustion to force an upward current immediately the fire is lighted. I prefer not to have a cone on the top of the outlet flue-pipe in the chimney, as it checks velocity, which is just what I do not want it to do. The diameter of the flue-pipe projecting down and above the chimney-top is of the same size as that of the flue of the gas-fire. What is the result? I practically destroy the pressure in the chimney by preventing the access of down-draught. I establish an equilibrium; and immediately the fire is lighted, an upward motion of the air in the chimney takes place; and as the enclosed space around the 2 feet or 4 feet length of pipe projecting down the inside of the chimney gets warm (and the hotter it gets, the more efficiently it works), a strong upward current is induced, and the whole of the flue gases in the chimney are kept warm, and consequently ascend rapidly. I have found that the strongest down-draught can be cured in this way. I shall refer to this again, when relating some experiences.

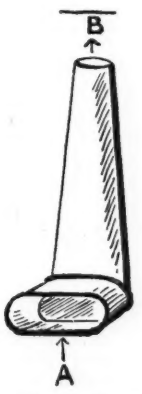


Diagram No. 3.

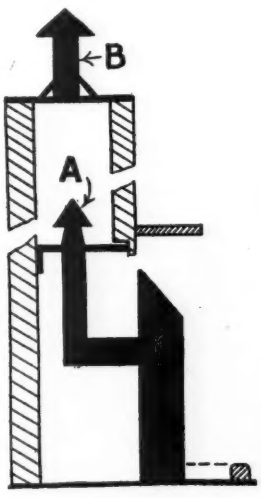


Diagram No. 4.

I do not believe in the diminishing or reducing of stove-flue elbows, similar to that pictured in Diagram No. 3. I have known of cases where the up-draught in the chimney was so great that the heat was drawn up the chimney as soon as generated, and the rush of cold air towards the fire kept the iron front of the stove

cold. In such cases it is easy to attach a diminishing piece of flue-pipe to the outlet of the flue elbow (see A, Diagram No. 4); and if it is then found that the up-draught is too great, I would fix, on the top of the chimney, a similar arrangement to that used in Diagram No. 2, but without the projecting piece down the chimney (see B, Diagram No. 4), and would reduce the diameter of the pipe until I had secured the desired effect. But this is rarely necessary. In one particular case, where the top of the chimney was inaccessible, or practically so, I obtained the desired result by fixing a reducing-piece of flue-pipe to the flue-elbow, the diameter of the pipe being reduced from 3½ to 1¼ inches. There is no "Royal Road" for the fixing of gas-fires.

Mr. F. W. Goodenough, the Controller of the Gas Sales Department of the Gaslight and Coke Company, truly said, in his speech at the meeting of the Institution of Gas Engineers in Dublin in June, 1907, "it was almost impossible, and altogether misleading, to lay down any definite rule as to how they were going to fix a gas-fire, because local conditions varied so greatly that every case had to be treated on its merits." I therefore trust you have not been thinking that I was going to show you a "Royal Road." I can only point out, as clearly as possible, those methods which I adopted in dealing with certain difficulties, and which proved to be successful in operation. Manufacturers have their difficulties in regard to gas-stove construction. Mr. H. J. Yates, the Managing-Director of Messrs. John Wright and Co., also spoke at the Dublin meeting, and said "flues varied very much. If they could depend on a constant pull, they would not have to draw so much heat up the flue. As it was, makers had to leave a big margin to go through the flue to locate a pull." It is this margin in stove construction, referred to by Mr. Yates, and the "local conditions" surrounding and controlling the action of chimneys, as referred to by Mr. Goodenough, that the practical and intelligent gas official has to plan for, contend with, and conquer.

Ascertaining the Natural "Pull" of Flues.

I think it might not be out of place were I to refer here to one or two points connected with the "pull" of stoves, and the "difficulties" mentioned by Mr. Yates at the Dublin meeting, and more particularly respecting the "margin" referred to. Knowing that many difficulties were not caused by down-draught, but through want of "pull" or "up-draught" in the chimney, I made a series of experiments about three years ago with a view of ascertaining the natural "pull" of the flues of various portable gas-fires; and the results were exceedingly interesting,

I tested sixteen gas-fires with and without a talc eduction-valve; and the flue-elbow or flue-pipe, according to the test made, was in no case carried into a chimney—indeed, there was no chimney-flue in the room. Reducing elbows were not used. Full-way elbows were fixed equal in diameter to the flue of the gas-fire; and the talc eduction-valve fixed on top of the elbow or flue-pipe was of the same diameter as the flue-pipe. A governor was fitted to each fire to regulate the consumption; and the pressure on the outlets of the governors varied from 15-10ths to 17-10ths. As you all know, the weight of the talc valve in an eduction-valve is very slight indeed. My first experiment was to test the sixteen stoves with elbow and eduction-valve only in use (see B, Diagram No. 5); and after thirty minutes' burning, the talc valve had not risen in fourteen of the sixteen stoves. On one stove, the talc valve rose slightly after 15 minutes' burning; but the draught was *nil*. After 30 minutes' burning, it had not risen ½ inch; and the draught was then bad. In the other stove, the first movement, just a slight rise, took place in 5½ minutes, but was no higher after 30 minutes' burning; and the draught was also bad.

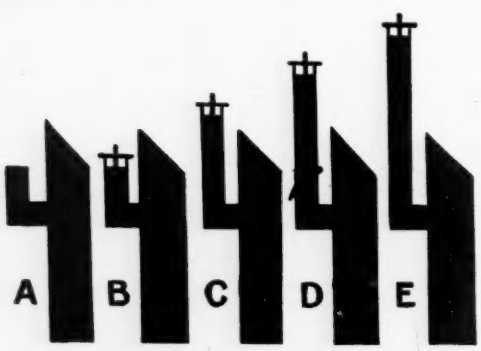


Diagram No. 5.

Each of the fires was tested without the eduction-valve (see "A," Diagram No. 5); and the results were as follows: Seven fires, draught bad. Nine fires, draught not good. Each fire was next fitted with a 2-feet length of flue-pipe on the elbow and eduction-valve on the top of same (see C, Diagram No. 5). The results were still unsatisfactory, as the following record shows.

2 stoves—valves rose slightly in 50 minutes; draught in one case bad, and in the other not good.
1 fire—first rise of valve 17 minutes; draught not good; full action in 24 minutes; draught good.
1 fire—first rise of valve 8½ minutes and valve rose 1 inch in 30 minutes; draught not good.
1 fire—first rise of valve in 3½ minutes; no improvement in 18 minutes; and draught bad in both instances.
1 fire—first rise of valve 5 minutes; and draught then good.
1 fire—took 6 minutes to raise valve 1 inch; draught then good.
1 fire—3½ minutes first action of valve; in 8 minutes not much better; draught not good; 1 inch rise in 11 minutes; and draught good.
5 fires—results as follows: 2 fires no action of valves in 18 minutes; 1 fire no action of valve in 105 minutes; and the other two no action in 120 minutes.
1 fire—first rise in 12 minutes; 18 minutes no improvement; and draught bad.
1 fire—first rise in 3 minutes; in 3½ minutes rose ⅛ inch; and in 8½ minutes ¾ inch; draught at latter time good.
1 fire—first rise 1 minute; in 1⅜ minutes the valve rose ½ inch; and in 6 minutes it had risen 1 inch; and the draught was then good.

Without the eduction-valve, the results of the draught tests in fourteen of the stoves were as follows: Good, 10. Bad, 1. Not satisfactory, 1. Good after 2 hours—viz., when stoves were very hot—2. The other two were not recorded.

A few of the stoves which were not satisfactory in the previous test, were tested with 4 feet of flue-pipe and an eduction-valve fitted on top (see D, Diagram No. 5); and the results were as follows.

1 fire—first rise of valve and full action 28 minutes; draught then satisfactory.
1 fire—first rise of valve and full action 21 minutes; draught fair.
1 fire—first rise of valve 7¾ minutes; full action 10 minutes; draught good.
1 fire—rise of valve 45 seconds; full action 1½ minutes; draught good.
1 fire—first rise of valve 12 minutes; 34 minutes ½ inch rise, draught bad; 41 minutes full action, draught good.
1 fire—first rise of valve 10½ minutes; 12 minutes ½ inch rise, draught bad; 41 minutes full action, draught not good.
1 fire—first rise of valve 11 minutes, draught bad; 17 minutes ½ inch rise, draught not good; 30 minutes full action, draught good.

The results without the eduction-valve in five cases were as follow: Good, 2. Fair, 1. Good after half an hour's burning, 2.

Five of these fires were fitted with 6 feet of flue-pipe and an eduction-valve on top (see E, Diagram No. 5), with the following results.

1 fire—valve rose in 16 minutes; draught then good.
1 fire—valve rose in 45 seconds; draught then good.
1 fire—first rise of valve 10 minutes, draught bad; 15 minutes valve rose ½ inch, draught fair; 26 minutes, valve in full action, draught then good. The governor to this fire was out of action; and it was tested at a pressure of 26-10ths.
1 fire—first rise of valve 6½ minutes, in full action; and draught then good.
1 fire—valve rose ½ inch in five minutes; 9 minutes' full action, draught good.

Tested without the eduction-valve on the top of the flue-pipe, I found that the draught of each fire was good. These experiments proved to my mind that some gas-fires were designed and constructed in such a way that they depended entirely upon the pull of a chimney for satisfactory working. When there was great density in the outside atmosphere, or other unsatisfactory conditions prevailed, the products of combustion from these stoves would escape into the room. The more you study this question, the more you will find that there are times when the influence of the upper winds will cause a natural and efficient up-draught in the chimneys, and others when an apparent down-draught exists, but which is not in reality a down-draught but want of up-draught; and gas-fires constructed on lines similar to some of those mentioned by me will not work satisfactorily unless there is a natural up-draught in the chimney-flue.

Air movement, or wind, plays a very important part in the pull of chimney-flues. A great deal depends on not only the quarter from which the wind is blowing, but as to whether it is a low wind or a high or sky wind. By a low wind, I mean a wind that blows near the earth, and by a high or sky wind one that is blowing with more or less force at a considerable height (viz., in the upper air regions) and which has a tendency to create, as it were, an exhaust—that is, by drawing up the air from the earth's level and thereby causing a strong up-draught in the chimney-flues. I have not been able to prove the correctness of this belief; but only the existence of some such influence could possibly account for many of the difficulties I have had to deal with. I mentioned this view one day to a friend of mine (a chemist); and he suggested that possibly northerly and easterly winds, being dry and void of moisture, might be considered up-draught winds, and also by reason of their circular action—thus inducing a suction from the earth towards the centre of the whirlwind area. The south wind, consisting naturally of a warmer air, was light in character; and, consequently, it conduced towards creating an up-draught by offering less resistance than the air of greater density. Westerly and south-westerly winds he denominated as down-draught winds. The air, being charged with moisture, made it heavier; so that its tendency was to drive downwards towards the earth. My friend based his theory on the supposition that the house stood in a field, and was not,

therefore, subject to the influence of air currents and down-draught winds created by adjoining or surrounding buildings. For instance, a chimney from a low house backing against a wall of a very much higher house would be subject to down-draught whenever the wind blew from a quarter opposed to the wall.

The trouble encountered from time to time of a fire giving complete satisfaction at one time while behaving abominably at others, is therefore easily accounted for. The moral to be deduced is that in such cases the chimney is one susceptible to varying conditions of weather; and steps should therefore be taken to examine its working under different climatic conditions, so as to learn how to overcome the trouble. In connection with this part of my subject, I may point out that some manufacturers, in their anxiety to design a stove with a view of getting great heating results, contract the flue, or obstruct the passage from the canopy to the flue-outlet, for the purpose of retarding the escape of the hot flue gases in order that the convected heat chamber may be heated up as much as possible, and so increase the utility of the stove. Such a stove is useless if fixed in a room where there is no natural pull or up-draught in the chimney-flue, unless a flue-pipe of sufficient length and equal in capacity to that of the flue of the fire is extended up the chimney from the outlet of the stove-flue. This practically acts as an exhaust, induces velocity, and assists the progress of the products of combustion up through the chimney-flue proper.

Confusing Want of Natural Upward Flow with Down-Draught.

It is a common error on the part of some gas-fitters to confuse this want of a natural upward flow (caused by the density of the atmosphere or some other circumstance) with down-draught. The two different conditions may be easily distinguished, as the former is continuous in its effect, while the latter is intermittent—coming in gusts according to the structural conditions of the neighbouring buildings, walls, &c., and other influences. In the course of my many experiences of stoves fixed on districts, I have obtained great assistance from time to time by referring to the daily weather charts published by the Meteorological Office. They record prospective changes of weather, and can be obtained for a very small sum. I remember one especial occasion that a number of stoves had been fixed (many of them designed to give great heating results), and had all been working satisfactorily for about two weeks or so, when suddenly difficulties presented themselves. There was no wind to cause down-draught, yet the fires suddenly developed symptoms of such, and began to work most unsatisfactorily. I had been studying the daily weather charts for several days, and upon referring to them for an explanation of the cause of the unsatisfactory working of the fires, obtained the following information. "Since yesterday morning the barometer has fallen over the whole of our area. It is still falling slowly generally." "A thunderstorm with very little rain passed over London during the evening." This latter condition was anticipated in the report of the previous day; and in the report of the day before that, it was announced that, "Before the ensuing 24 hours has elapsed, our western districts will come under the influence of another low-pressure system approaching from the Atlantic." On the evening just before my difficulties presented themselves, the air was calm; but on the following morning, there was just the very slightest breeze imaginable. For the 24 hours ending at 8 a.m. on the morning of the first-mentioned day, the temperature in London ranged from a maximum of 65° Fahr. to a minimum of 48° Fahr, and for the 24 hours ending the following day from a maximum of 75° Fahr. to a minimum of 52° Fahr. The information obtained assisted me in corectly diagnosing the cause of the difficulties.

The chimneys were exceedingly long ones, and got filled with cold air during the night; and to make the stoves work satisfactorily under all conditions of the atmosphere, I found it necessary in every case to remove the manufacturers' elbows, and to fix equal or full-way elbows—*i.e.*, with the outlet capacity equal to that of the inlet—and to use flue-pipes of equal diameter. The length of the flue-pipes had to be extended from 2 feet to 4 feet or 6 feet up the chimney, and in the case of one fire to 7 feet. I also found it necessary to remove the cones from the tops of the flue-pipes attached to the gas-fires, to allow of free draught passing upwards from the flues of the gas-stoves. The velocity of the gases issuing from each flue-pipe had to be powerful enough to force an upward flow in the chimney immediately the fire was lighted, and not some time after it had warmed to its work, because while the gas-fire, fire-flue, and chimney-flue were warming up, the products of combustion would have escaped into the room from under the canopies, and vitiated the atmosphere.

I am very strongly of opinion that no stove should be adopted and recommended until it has been tested in every possible way, and its utility and efficiency placed beyond doubt. I would also like to see all gas-fires fitted with governors. The burners should be regulated to give the best possible results at a uniform pressure of (say) 2 inches; and manufacturers should design their stoves in order to work at that or some other generally accepted and adopted standard of pressure. This would do away with one of the difficulties which Mr. Yates referred to at the Dublin meeting. Mr. Smith, of Leeds University, however, declared that, in testing fires for radiant efficiency, pressure did not count, but only the gas consumption and the quality of the gas. When fixing fires on the district, the air and gas regulators should be adjusted to give the best possible results at the pressure for which the stove is designed; and I consider injector regulators are highly necessary.

For testing the draught of a gas-fire, I have found the following plan serviceable: Take a length of wire and encircle one end round an absorbent plug of cotton waste, saturate it with colza oil, light, and let it burn until quite hot, then smother the flame with a cloth and place the plug in front of, or inside, the canopy of the fire. The oil will give off a smoke easily discernible. This colza torch, when plunged into the canopy chamber above the incandescent fuel, will not melt as a wax-taper will, and smoke will continue to be given off until all the oil is consumed; and if the draught of the fire is bad, it will escape continuously, or in puffs, from under the front of the canopy.

Important Points about Fuel.

One very important question in connection with the construction of gas-fires is that of the so-called fuel. At the Dublin meeting referred to, a very interesting paper was read by Mr. J. H. Brearley, a gentleman who has devoted a great deal of study to the testing of gas-fires. We are all aware that one of the most poisonous products of imperfect combustion is carbon monoxide; and respecting this, Mr. Brearley stated that "it had been proved that when flame came into contact with cold surfaces, carbon monoxide is produced." This it is important to remember.

It is now well known that any material which breaks across the inner cone of a bunsen flame causes imperfect combustion. This was pointed out by Mr. Vasey in 1893. It is, therefore, very necessary for fitters, when attending to complaints, to bear this in mind; and it is essentially necessary for a man to possess the faculty of being able to distinguish by smell, when, through imperfect combustion, acetylene or other impure gases are being diffused from a gas-fire.

I have often wondered at the name "ball fuel;" and it would be interesting to know how this name came to be adopted. Personally, I am not in favour of the continued use of ball fuel, though in some fires—through the fuel being raised some distance above the flame-holes of the burner—no very serious results follow its use, except when the material breaks and portions of of it fall across the orifices of the burner, when at once imperfect combustion of the flame from the orifices affected, with its attendant evils, follow. I prefer—and most gas-fire manufacturers do now—the "hollow perforated incandescent tubular gas-fire mantles." This long-winded description is mine; and you may perhaps therefore realize why the phrase ball fuel came to be coined. For convenience, I suppose, we shall coin another phrase—viz., "tubular fuel," or "the tubular gas-fire mantle," or, as Mr. Smith, of Leeds University fame, calls it, "columnar fuel," and Mr. Yates "the radiant."

In stoves specially constructed for this kind of fuel, combustion is perfect so long as the fuel remains whole and in its proper position. It should be made to give the highest amount of radiant heat possible, and incandescence should follow quickly after the ignition of the gas. Mr. Smith's report on the question of fuels is most interesting and valuable. Gas companies owe much to Mr. James Wilson (Messrs. Wilsons and Mathiesons, the pioneers in "columnar fuel") for improvements in this direction; also to Messrs. John Wright and Co., the Davis Gas-Stove Company, Messrs. R. & A. Main, and others who have followed on similar progressive lines. The great difficulty to contend with in gas-fire maintenance is the destruction of the fire-mantle. It is immaterial whether ball, tubular, or columnar fuel is used, its fragile nature is such that the housemaid's or house-wife's black-lead brush, in addition to other causes, does tend towards damaging it.

Mr. Smith, of Leeds University, made a number of experiments as to the construction of "fuel" and its efficiency as a radiating medium after construction; and at the Leeds University meeting in November last, he pointed out—as most of us probably know already—the necessity for the whole of the fuel to be in close contact with the whole of the outer cone of the flame, and that it should be as "porous as possible on the surfaces." He also explained that the rougher the surface the better would be the radiant efficiency of the "fuel." But it did not appear that durability was also considered an essential quality; and those of us who have to consider the cost of maintenance believe this question to be one of the greatest importance.

I would suggest that a trial be made of a reflecting brick designed with semi-tubular or columnar mantles of fire-clay fuels projecting from same. The fuels could be made "ᗡ" shape, and arranged to be kept in position by means of grooves—a front bar would then be unnecessary. This would materially strengthen, and, I suggest, might greatly increase the life of, the fire-mantle, thereby reducing maintenance charges. I would also like to know whether, by fitting a cushion of asbestos or slag wool behind the back brick, the radiant efficiency would be increased. Mr. Smith ascertained that the higher the temperature of the back brick, and the lower the loss of heat through it, the greater the amount of radiation from the front of the stove.

In the discussion which followed the reading of the Research Committee's report at the meeting of the Institution of Gas Engineers in June last, Mr. Thornton stated that his firm's experiments had proved that higher efficiency was experienced when there was a "pad" of air between the fire-brick and the fuel. Personally, I have not been able to make research experiments in this direction. However, a friend of mine (a retired Government Surveyor) informed me some years ago that he had obtained greatly increased heating results from a coal-fire by using a 3-inch pad of slag wool at the back of the sloping brick of a coal-fire grate; and if he is correct, I see no reason why it should not hold good concerning gas-fires, and especially when it is considered that this system is universally adopted by gas-stove manufacturers in the construction of all gas-cookers, and for the conserving of heat in ovens, and to

prevent its radiating from the outer case. I would ask my scientific friends whether the use of slag wool or asbestos as a pad would not prevent the conductivity referred to by Mr. Smith. When replying to Mr. Thornton's observations, Mr. Smith said that the reason why a higher efficiency was obtained when there was a pad of air between the fire-bricks and the fuel was due to less conductivity, and that back bricks also increased the radiating efficiency through the same cause.

On Taps.

The late Mr. William Sugg, many years ago, designed a very effective gas-fire, called the "Charing-Cross Fire," which was fitted with the so-called "finger" burners. The inner cone of the bunsen flame did not come in contact with the ball fuel or small log fuel he often used; and as each flame was governed by a separate tap and governor, satisfactory combustion followed.

I believe—and my opinion is based on practical experience of consumers' complaints and difficulties—that every portable gas-fire should be fitted with a tap for lighting and extinguishing purposes. It should be fixed as close to the burner as the construction of the fire will permit. The presence of such a tap enables a consumer to reduce to a minimum the internal explosion which always follows the turning off of a bunsen burner, and which troubles some nervous people considerably. When a governor is not fixed to a fire, another tap, fixed from 3 to 4 feet away from the tap attached to the fire, and used for regulating the pressure required only, will minimize the hissing noise so often complained of through excess of pressure, and will practically cure same. The turning down half-way of the tap controlling a gas-fire also often causes a very irritating noise; and the presence of this second tap will prevent it. It is not always that a fire is wanted to burn at its maximum consumption. The heat may be required to be varied hourly; and consumers have to turn down the burner. We should make our fires as unobjectionable as we can.

Better still would it be if every gas-fire could be constructed on the duplex-burner system, which would ensure a useful, efficient, and economical fire. With reference to this question, I might here quote from Mr. Smith's report in support of this view—viz., "After a stove has been burning some time in a room, it is frequently found that, when the desired temperature has been reached, it may be maintained by turning the gas off a little; but if turned down beyond two-thirds of the full consumption, the radiant heating efficiency falls with the consumption, owing to the shrinkage in the size of the flame causing it to burn completely out of contact with the fuel." The duplex burner gets over this difficulty.

Rooms with More than One Chimney.

When arranging for gas-fires, it is most important to ascertain whether there is more than one chimney-flue in the room, because if there are two flues—one at each end of a large room—it is probable that when only one fire is alight it will pull air down the other chimney. This will also sometimes happen when both fires are alight, especially if one chimney has a sluggish action and the other a swift up-current. I have found this drawing-down action cause a fire to continually fire-back. Under these circumstances, one has to equalize, as far as possible, the pull in the two chimneys. I well remember the case of a large drawing-room where a coal-fire was used at one end, and a rather large portable gas-fire at the other. At the time of my visit, the coal-fire was not alight; but when I lighted the gas-fire, I found products of combustion escaping largely from under the canopy. Upon examination, I discovered that one of those unfortunate reduced elbows (see Diagram No. 3) had been fitted. Excepting with a very strong up-draught in the chimney, the gas-fire could not be expected to work satisfactorily. On the other hand, there was a strong down-draught at times—which was worse when the coal-fire was lighted. In this case, the register was filled in, as in Diagram No. 2, a full-way elbow was fitted, 6 feet of flue-pipe was extended up the chimney, and one of the cowl arrangements was placed on the top of the chimney with a 3½-inch flue-pipe projecting some 3 feet down the chimney and 2 feet above, with successful results.

Many years ago, I had experience of a large workshop which was warmed by two anthracite coal-fires placed at different parts of the shop, and having 6-inch flue-pipes—one being nearly twice as long as the other—and both were carried into one chimney-flue. The result was that, in certain conditions of the atmosphere, and owing to the density of the fuel gases, the products from one fire came back through the flue-pipe of the other and put out the fire. I believe the result would have been the same had the stoves been fitted with gas-fires instead of anthracite coal. I showed my friend how to cure this. One flue was carried some distance higher up the chimney than the other, and the fire to this flue was always lighted first so as to induce an up-draught, and dampers were fitted in the flues to regulate the draught.

Fires in Coal Grates.

With reference to the question of burner fires, or fires built in coal-grates, my previous observations apply with equal force in these cases. Velocity must be conducted at the base, and the outlet of the chimney balanced as suggested in Diagram No. 2. The following case, which I had special cause to remember, was successfully dealt with by me. A short chimney was backed by a high wall, with the result that when the wind blew in a certain direction a very powerful down-draught was experienced. I fitted a "funnel cone" to the register opening of the grate; and at the reduced end, or apex, of this funnel cone was fitted 4 feet of flue pipe, which extended up the chimney. The cone was cemented in at its base; so that there was no passage to the chimney, except through the cone and the 4-feet length of flue-pipe. On the top of the chimney I fitted one of the down-draught arrangements (as illustrated in Diagram No. 6) with 4 feet of flue-pipe projecting down the chimney and 2 feet above, with a small cone on top, with the result that the down-draught was cured. A is the cone fitted

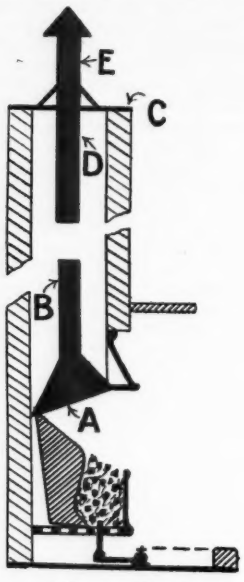


Diagram No. 6.

to register, and B is the 4-feet of flue-pipe attached, which may be straight or conical as desired. I usually advise the base of the upright pipe to be 6 inches in diameter, and the apex 4 inches. C is the cap on the top of the chimney, D the 4 feet of flue-pipe projecting down the chimney, and E the 2-feet length of flue-pipe with cone fitted above the chimney top.

A great deal will depend on the design of the grate and the position of the register. The flue-pipe attached to the cone must be extended, as I have previously explained, sufficiently high up the chimney to induce an upward flow, so that when the fire is lighted, the products will be conducted or attracted to the cone, and ascend rapidly through the length of flue-pipe.

The size of the flue-pipe should be regulated according to the quantity of gas to be consumed; and the cone should have a gradual—not acute—rise from the base to the apex. For fires of 25 cubic feet consumption per hour, the apex of the flue-pipe may be 3 inches in diameter; from 30 to 40 feet, 3½ inches; and from 40 to 50 feet per hour, about 4 to 5 inches. With a good cone, I think a flue-pipe 6 inches in diameter at the base and 4 inches at the apex suitable for most fires; but circumstances may necessitate a flue-pipe with the apex 5 inches in diameter.

In another particular case of a fire fixed in a large dog-grate, a canopy had to be attached to the roof of the recess in which the dog-grate stood; but products of combustion continued to syphon, under certain atmospherical conditions, from under the sides of the canopy. But by sharpening the access to the chimney-flue by inserting a funnel-shaped cone in the canopy (the base being

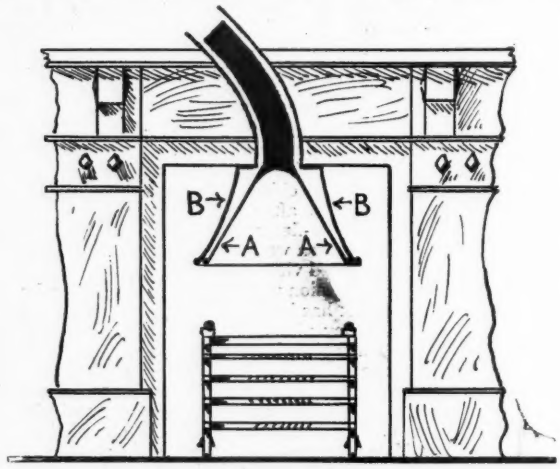


Diagram No. 7.

practically the same area as the bottom of the canopy, which was reduced at the apex to 6 inches in diameter), the draught was under all conditions satisfactory. Diagram No. 7 illustrates the work done—A being the funnel-shaped cone referred to, and B the brass canopy into which the cone was fitted. You will note

that the chimney-flue in this case was difficult to deal with. I did not find it necessary to fix the special down-draught arrangement on the top of the chimney—there being an Empire cowl upon it; and the draught was satisfactory when there was plenty of wind to cause it to rotate. In still weather, the arrangement mentioned brought about the desired result.

In fitting "burner-fires," the fuel should in every case be kept clear of the inner cone of the bunsen flame. Otherwise imperfect combustion will follow; and no matter how good the draught may be, some of the impure gases may diffuse and mix with the air of the room. These burner-fires may give unsatisfactory results where conditions are not favourable—viz., where fitting has been done badly by some private incompetent gas-fitter, and the pipe laid to same too small, and the pressure in consequence too low.

In one case I investigated, there was only 5-10ths pressure within 18 inches of the fire when it was alight. There was a strong up-draught in the chimney. When the fuel was removed, the draught from under the door of the room travelled along the floor, striking the flame, and curving it towards the back of the grate. This was due to the flabbiness of the flame, and was caused by the low pressure. The effect of this was, when the fuel was in the grate, and even with a consumption of 25 cubic feet per hour, for the front part of the fuel to remain white and the back part only to become incandescent. When the pressure was increased to 11-10ths, the flame became rigid, and resisted the floor draught. The result was that the front part of the fire became incandescent, and, of course (as you are well aware), the greater the pressure the more rigid will be the flame. One fact I may mention is that the warm air in a house, and the existence of other fires in use, be they coal or gas, may also tend to pull air down certain chimneys.

Some More Experiences.

I had one experience which gave me considerable trouble (see Diagram No. 8). Two rooms adjoined each other, one large marked A, and the other a very much smaller room marked B. In the big room was a large portable gas-fire C; and in the small one, a somewhat smaller gas-fire D. When the door intervening between the two rooms was opened, the strong pull of the chimney in the smaller room caused a very powerful down-draught in the chimney of the larger room, in spite of the more powerful gas-stove; and by shutting the intervening door referred to, and opening and shutting the window E, I could influence at will the up or down draught in the chimney in the large room. It was found that there was a connection between this chimney and another from one of the lower rooms, which was subsequently remedied.

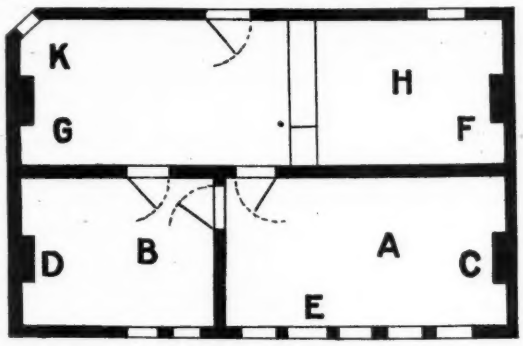


Diagram No. 8.

Adjoining these two rooms, and running parallel with them, was the outer office, which also contained two fire-places marked F G, in front of which two of the smaller class of portable gas-fires were fixed. The office was divided by a counter, and behind the counter was the office H, running parallel with the larger room A. The gas-fire F in this part of the room always smelled of products, unless the window K at the opposite corner of the room was opened some inches at the top. Immediately this window was shut, the natural up-pull in the chimney G near the window, even when the gas-fire was not in use, would cause a down-draught in the chimney F at the opposite end of the room, where the other gas-fire was alight. The following are particulars of our work as it was finally completed.

Fire-place C (see Diagram No. 2), large portable gas-fire. Flue-pipe B, 4 inches in diameter; length of same, 4 feet. A, 4-inch down-draught arrangement fitted on the top of the chimney; 3 feet projecting down chimney and 2 feet above. Fire-places F and G, small portable gas-fires. Flue-pipes practically 3 inches diameter; length of same, 2 feet (see B, Diagram No. 2); 3-inch down-draught arrangement (see A, Diagram No. 3) fitted on top of chimney; 3 feet projecting down and 2 feet above. Fire place D, small portable gas fire, 3-inch flue pipe, length 2 feet (see B Diagram No. 2). The down-draught arrangement A was not fitted to this chimney; it being unnecessary. I would add that the doors and windows in these rooms shut very closely, and practically sealed ventilation, excepting by opening windows. These were casement windows, opening outwards.

I might here point out—although I have no doubt that you are all aware of the fact—that, under certain atmospheric conditions, the smoke from a coal-fire, or the products of a gas-fire, may syphon from its own chimney top down the adjoining chimney into the room below. I have found that when this occurs, it is generally when the air above is still and cold and weighty, by reason of its own density, from one cause or another. But it will sometimes occur when a light breeze prevails, or when there is a downward draught in one of the chimneys. There being no fire in the grate below, and the warm air in the room, or other causes, will create a suction down the chimney, and the smoke or products of combustion are consequently drawn down from the adjoining chimney. A simple remedy I have found is to lengthen the chimney by raising the top some 3 or 4 feet above the other.

I remember a case where a gas-fire on the top floor of a high building was stated to light-back occasionally without apparent cause. Subsequent investigation proved that, under certain conditions, this was due to the air being pulled down the chimney by the descending lift at the side of the staircase, and when the room door was open at the same time. The suction was so great that the flame was drawn down and ignited the gas at the injectors in the mixing-chamber.

Points to Remember.

Another point to remember in connection with complaints that gas-fires smell, is that London air is very plentifully charged with dust and fluff; and when this dust-laden air passes through the convected-heat chamber of a gas-fire into a room, it may give off a slight smell. During the period the stove is out of use, especially during the long summer months, a lot of this dust accumulates in the convected-heat chamber; and immediately the fire is used again, and the chamber is heated, the stove is complained of as smelling. I know by experience how difficult it is to convince consumers that the smell is due to the baking of the accumulation of dust, and is only temporary.

Convected-heat chambers should be so constructed that they may be easily got at, and be able to be taken apart and cleaned before the winter season begins; and it would be possible to construct stoves designed to give convected heat in such a way that the convected-heat chambers could be closed during the summer season. This would also enable a consumer to obtain radiant heat only, or radiant heat and convected heat combined, as might be desired. Fitters, and indeed all gasmen, should be able to detect whenever a complaint is due to this cause; and it should be intelligently explained to the consumer, and the dust removed from the chamber if the construction of the stove will permit. A force pump, or even a pair of bellows, will be found a useful means when the chamber is a fixture.

It is surprising what mistakes some unthinking, untrained, inexperienced (I mean inexperienced in flue-draughts) gas-fitters will make, when attempting to deal with a gas-fire difficulty; and this peculiar characteristic is not by any means confined to our own business.

A Troublesome Case Cured.

A lady bought a large portable gas-fire to stand in front of a register grate in her dining-room. This room was built out from the house, and was a sort of an annexe. The chimney was a short one, and almost perpendicular in its ascent; and the building was surrounded by larger buildings, and a cleared site adjoined the

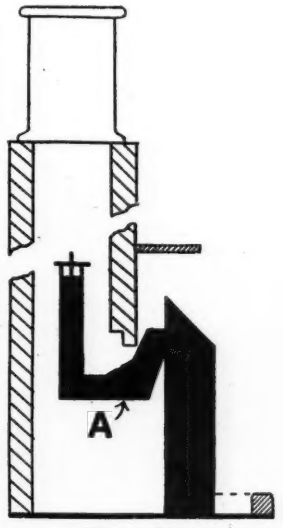


Diagram No. 9.

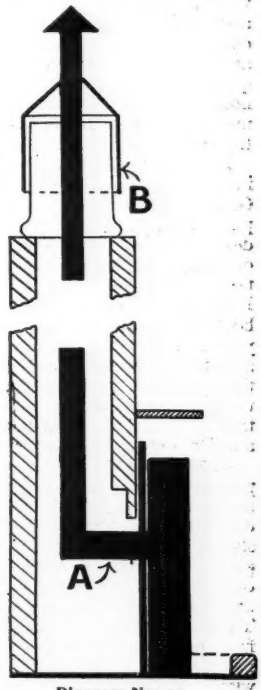


Diagram No. 10.

rear wall of the room—one of the worst possible conditions conceivable for flue-draught. The flue of the gas-stove was considerably higher than the canopy of the coal-grate, so the gas-fitter fixed a special turn-down elbow, as in Diagram No. 9. This elbow

was reduced from 4½ inches in diameter at the outlet of the gas-flue to 3 inches at the outlet. Another flue-elbow, 3 inches in diameter, was attached to this elbow, to turn the flue up through the register of the grate; and a 2-feet length of 3-inch flue-pipe was extended up the chimney. And as the fitter had possibly heard that one of the eduction-valves which I have previously referred to was "good for down-draught," he fixed one on top, as in the diagram. The result was that the products of combustion could not possibly get away, and an already difficult chimney-flue was made more difficult and practically impossible of action. Special mechanical means of suction only could have brought the stove-flue into action. Needless to say, the whole of the products of combustion escaped into the room from under the canopy, and must have done so from the moment the stove was fitted. No other result could have been expected.

I fixed an enamelled iron "tile" plate (see Diagram No. 10), coloured to harmonize with the decorations, in front of the fire-place or grate, fitted a suitable portable fire in front of it, and carried the flue-pipe A 6 feet up the chimney. The down-draught arrangement was fitted on top of the chimney-pot B, with 3 feet

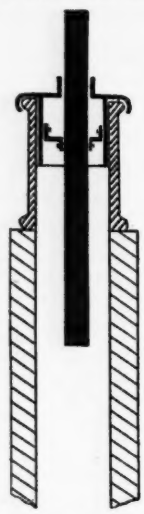


Diagram No. 11.

of flue-pipe projecting down the chimney and 2 feet above, with the usual cap on top. The result was perfectly successful; and at no time since has there been the slightest smell. The room is now properly warmed and efficiently ventilated.

It may interest you to know how I came to use this cowl. About thirty years ago, we were troubled with a down-draught in a top bedroom in my house; and we could not have a coal-fire at all in some winds—particularly during westerly or south-westerly winds. I consulted the late Mr. Prim, who was a friend of mine, and the Resident Engineer of the Houses of Parliament, who had charge of the ventilation there. He had been for many years associated with the late Dr. Percy in the heating and ventilation questions of the building, and he told me of the plan. I tried it at home with perfect success. I have merely adapted the idea given me by Mr. Prim to the various conditions I have met with from time to time.

I would like to mention, in connection with this subject, that in 1908, having prepared a paper on "Some Experiences with Gas-Fires" for the outdoor staff of the Gaslight and Coke Company, I had the night before it was to be read felt interested in desiring to know what progress had been made in the last twenty or twenty-five years, and when searching for some old reference or text-books in my book-cases, caught sight of a book entitled "The Domestic Uses of Coal Gas," by the late William T. Sugg. This book was published in 1884. I had not looked at it for very many years. I therefore took it down and glanced through its pages, and, to my surprise, in the plate facing p. 144, I found a sketch of the apparatus (see Diagram No. 11), but without the cap I use on top. Yet, after all, why should I be surprised, knowing as I do that the late Mr. Sugg was very closely associated with Mr. Prim and Dr. Percy in lighting and ventilating questions.

In Mr. Sugg's book the apparatus is referred to thus: "As the products of combustion from the gas-fire do not include smoke, and are not, probably, one quarter the volume of those from a coal-fire, the chimney-pot should be fitted with the arrangement shown in fig. 127, on plate 37." On page 139, I read this paragraph: "Down-draught, or the escape of the products of combustion into the room, can generally be prevented by a simple arrangement at the top of the chimney-pot (see page 127, plate 37). Thus arranged, many fire-places, which cannot be used with coal-fires, because of the smoke and blacks which are blown about the room when the fire is lighted in them, can be successfully used with a gas-fire." I am delighted to be able to quote my late friend's opinion on the arrangement which I have so often used and adopted in many cases of difficulty in conjunction with my own method of extending flue-pipes of varying lengths up chimneys at their base, and closing the entrance of chimney-flue and only allowing ventilation through the flue of the gas-fire.

The practicability of being able to extend the flue-pipe enables me to assert that any properly-constructed fire can be made to work satisfactorily in any chimney-flue, and I have not yet found the chimney which could not be satisfactorily dealt with. I will not say it does not exist; but I can, and do, assert that I have not yet found one.

In one building I thought that I had discovered the impossible. There were two chimneys to deal with—one 18 feet long and quite perpendicular (in fact, you could look up it and see the sky), and the other 120 feet long. Both fires were on the same floor level. In the former, I proved that the smell was due to the down-draught; and in the latter, to the difficulty in moving the column of air in the chimney when the fire was lighted. I studied the daily weather charts for quite a long period over this case. The plan in Diagram No. 2 cured the short chimney; the flue-pipe on the stove flue-elbow being 2 feet long, and down the chimney at top 2 feet. For the longer chimney, 6 feet of flue-pipe was fixed on the stove flue-elbow. I found this was absolutely necessary, in order to create the requisite velocity to start the up-draught in the chimney; but to counteract the upward rush when the chimney got warm, the diameter of the flue on top of the chimney was made ½-inch less than that of the flue-pipe attached to the stove.

Radiant and Convected Heat.

I have known, I think, nearly all, if not all, the gas-stove manufacturers, or their leading men, during my gas career; and I have always found them willing and ready to listen to any experiences that would help them to improve the construction of their stoves. They, and all of us, I hope, have grown in wisdom during our generation. Manufacturers should possess proper testing-rooms where fires could be scientifically tested before being put on the market; and the time is coming—and with some gas companies has already come—when every gas undertaking will have its gas-stove testing laboratory. Experience has convinced me that the manufacturers of gas-fires—and, indeed, all of us, whatever our knowledge and experience—have still a great deal to learn in the designing, constructing, and fixing of gas-fires.

It has been stated that about 30 per cent. of the heat from gas-fires is entirely lost; and the late Mr. Thomas Fletcher thought that in actual practice it might reach 50 per cent. Mr. Smith, in his report, said that in all probability the highest efficiency obtainable with the present type of open fire, where the air of the room has free access to the front of the hot fuel, will be little more than 50 per cent. One does not, therefore, wonder why makers design fires with obstructive flues for the purpose of retarding the progress of the heated products of combustion and utilizing the flame for the purpose of conveying convected heat into a room.

As a business man and a seller of gas, I do not believe in the general adoption of stoves giving radiant heat only. I believe that stoves giving convected heat may be economically used to warm our buildings, without the evils one manufacturer spoke of at the meeting of the Institution of Gas Engineers in June last. But there is a great difference between heat that will warm air to a reasonable and acceptable temperature and heat that will give a very high temperature. The effect of the latter is well known; it bakes up (scorches, as it were) the dust in the air. But where there is ordinary ventilation in a room or workshop, convected heat may be used to advantage and with great economy. I quite agree with Mr. Smith, who stated in his reply at the Institution meeting, "that it was not much use throwing away convected heat up the flue for the sake of saying one had not got any; it might as well be used while it was there." But means should be provided for the periodical cleaning out of convected-heat chambers; and for obvious reasons there should be no possibility of connection, through defect in construction, between the flue and the convected-heat chamber. It is for scientific men to state what the safe temperature of convected heat should be, and for manufacturers to try and give the heat required.

At the meeting in November last previously mentioned by me, Mr. Smith stated that if the temperature of a room was raised from 38° Fahr. to 60° Fahr. by convected heat, that would be satisfactory; and he affirmed that the percentages of radiant heat and of convected heat in a room should be taken as the efficiency of a gas-fire. My views are based on practical experience and the necessities of everyday life so far as this question is concerned; and I am pleased to quote the Gas Heating Research Committee in favour of my opinion. If you will refer to the report already mentioned, you will find the Committee state that there is no reason why the heat usually allowed to pass up the flue should not be utilized more than has been the case, but that a definite percentage of heat is necessary to maintain the flow of the products of combustion up the flue, and that the amount will vary with the height and construction of the flue.

I am convinced that all gas companies will find it to their interest to establish stove maintenance departments in connection with their work, in the same way as they have found it necessary to form departments to look after the incandescent lighting. One is absolutely as necessary as the other; and I have not forgotten Mr. Vasey's advice in 1892 as to the necessity for the occasional cleaning of burners of gas-fires. Men must be taught and trained to fix gas-stoves properly, and to adjust the gas-nipples and air-chambers so that the highest efficiency can be obtained from the flame. They must possess the knowledge as to how to adjust the "fuels." They should be taught the construction of all gas-stoves, and what to do under all conceivable difficulties which may arise in the district. They must understand pressure, and be taught all

that is possible to be known about flue-draught. This will help to destroy prejudice; and I look forward to the day when no house will be without its relative number of gas-fires.

I have for many years held the view that, for gas-fires, 9-inch chimney-flues are unnecessary, and that a 4-inch stoneware pipe with unglazed interior would be quite sufficient for any ordinary gas-fire. In some buildings, architects cannot spare the wall-thickness for 9-inch chimneys in all rooms; and therefore some buildings contain rooms with no chimneys at all. Now, a 4-inch (internal measurement) stoneware chimney occupies much less wall-space than a 9-inch brick or stoneware chimney, and in many cases would enable the architect to build the room with a flue which would be suitable for a gas-fire. Such flue-pipes could be placed around the iron columns supporting the floors, and be built-in with concrete. Many blocks of good class residential flats, or blocks of buildings for offices—where, in the former case, gas-fires are usually fixed in all bedrooms, and in the latter gas-fires have become almost a necessity on account of their convenience, cleanliness, and labour-saving qualities—would be suitable for such flue-pipes.

Size of Chimney Flues.

One great difficulty in all such premises is that of providing room for the storage of coal, and my plan would greatly diminish the necessity for storage. I was consulted by an architect some eighteen months or two years ago, and we discussed the question. Although he did not doubt the correctness of my views and assertions, yet he was not prepared to adopt them or to recommend the plan to his clients' consideration without some independent proof. To satisfy him that such a flue would be efficient, a practical demonstration was made to convince him that a 4-inch flue-pipe would be sufficient to carry off all the products of combustion from a gas-fire and to effectively ventilate the room. The test was carried out by Dr. John S. Owen, whom I have previously mentioned—a very able expert, and the Consulting Engineer to the Coal-Smoke Abatement Society.

The cubical content of the room in which the test was made—omitting furniture—was 2100 cubic feet. A large gas-fire was purposely selected, which had a consumption of 38·3 cubic feet of gas per hour. It had a sheet-iron flue-pipe, 4 inches in diameter and 58 feet long, and was exposed throughout, and was open at the top except for the usual conical cap. The stove was burning for 3½ hours, and the windows and doors remained closed, except when it was necessary for Dr. Owen or his assistant to enter or leave the room. Air was therefore only admitted through cracks in the boarding of the walls and flooring. The air in the room was tested periodically for carbon dioxide; and the first observation was taken before the fire was lighted, when carbon dioxide was found to be in the ratio of four parts to 10,000 parts of air, which, as you all probably know, is the amount that is generally present in London air. At the end of 3½ hours' burning, only 4·8 parts of carbon dioxide per 10,000 parts were present in the air of the room. To make the test, it was necessary that one person should be in the room for nearly 2½ hours. This person would produce 1·9 cubic feet (approximately) of carbon dioxide in the 2½ hours; and if not removed, the carbon dioxide in the air of the room would therefore have been raised to about 13 parts per 10,000.

Now any failure on the part of the flue to carry away the products of combustion would have at once become evident in an increase in the proportion of carbon dioxide in the air of the room. On the other hand, there was effective ventilation by the flue; for the proportion of carbon dioxide found in the air of the room remained practically constant during the test, increasing only from 4 to 4·8 parts in 10,000. There was no smell of carbonic oxide in the room such as would have been produced by escaping products of combustion, and the actual velocity of the draught in the flue was good from the start. A steady velocity of between 6 and 7 feet per second was found to be maintained during the test. In all, 1667 cubic feet of flue gases passed through the flue per hour. The experiment proved beyond contradiction that a 4-inch flue-pipe is sufficient to carry away all products of combustion from a gas-fire (Dr. Owen found that something over 6900 B.Th.U. were lost through the flue walls per hour, or about 34 per cent. of the total heat generated per hour); and a stoneware flue-pipe embedded in masonry would act much more effectively, as the transmission of heat would then be much less than the exposed sheet-iron flue, and, therefore, would have a stronger draught, with increased ventilating efficiency. I am glad to state that the architect referred to was entirely satisfied with the result, as also were his clients. Flue-tubes on the lines of the experiment have been built in the structure for the use of gas-fires; and I may add that the building is rapidly nearing completion.

Conclusion.

In this paper I have attempted to interest and instruct those who may not have had the experience that some of us have had of what is really a most important question, and a vital one to gas companies' interests. I have endeavoured to cover the field of—shall I call them?—gas-fire operations, not with a view of laying down hard-and-fast cast-iron rules for dealing with difficulties, but rather with the sole idea of leading up to an intelligent appreciation of them in relation to cause and effect, believing that I would have your sympathetic appreciation of my humble endeavours to elucidate, for the benefit of some who may require instructing, the problems and difficulties attending the whole question, and believing that all of you, like myself, have been sorely puzzled at times.

Discussion.

Mr. F. Ainsworth said he much regretted that there would not be time enough to discuss the paper as fully as it undoubtedly deserved. Anyone who had much to do with the fixing of gas-fires would realize that there would certainly be difficulties in every district; and if an inspector told him that he had never found any difficulty in his district, he would not believe him. Some fifteen years ago, he himself had a very difficult fire to deal with; and it happened to be in the house of a friend of his. The chimney had been raised three times, and tops had been put on for dealing with the chimney draughts, besides other work being carried out. Still it would not act. Well, he simply did what Mr. Browning had done; he increased the length of the flue. Until they had the chimney warm, they could not get a fire to burn really successfully. The tendency was for the draught to come down to the warm part of the room, if it had the chance. In view of the opinions that used to be held on the subject, he was a long time before he could decide to have sheet iron fixed behind the stoves. But he had come finally to the conclusion that it was better to do so; and since then the trouble experienced had been very small indeed. As to reducing the flue-pipe, this was a course which he thought was very successful in many cases; but to his mind what they required was the fixing of an adjustable flue, though, of course, this had been condemned in many quarters. He had had to put adjustable flues in fires which previously did not give satisfaction, but had done so since; and he had never known a failure. He would not, in a general way, recommend that the flue should be reduced to 1¼ inches; what they wanted was some method by which the reduction could be made at will. He had not yet seen an adjustable flue that satisfied him; but he would like to have Mr. Browning's opinion on the matter. The question of pressure was one to which they must give attention; for the time had come when they must get the fullest possible results out of the gas consumed, or someone else would step in. It was only by doing this that they could continue to be as successful as in the past with fires.

Mr. F. S. Larking remarked that, looking at the diagrams, one of the things that struck him was, Why, in the case of these elbows, should they not substitute bends? An elbow took off from 35 to 40 per cent. of the efficiency. It meant that they were going to choke the flue down considerably in the first place before giving the gas a chance to get away. The blocking-up of chimneys was very important; and the efficiency of stoves was largely augmented by it. Otherwise a quantity of air passed to the side of a fire and went up the chimney without going through the fire itself. If one sat in front of such a fire, it would be found that the draught was sufficient to keep the feet cold a little way away from it; but if blocking-up was resorted to, there would at once be a noticeable difference. As to radiant *versus* convected heat, he thought that it was a question whether the radiant heat which the makers were so intent on getting now was not doing away with some of the convected heat which was necessary to warm a room thoroughly. Radiant heat was far too local to heat up a room properly. Convected heat, provided the temperature did not get so high as to burn up the particles and make them smell, was useful for warming up a room. One thing they should see to was that a fire had a good canopy. It seemed to him that with several of the modern fires there was a great risk of the side draught that was experienced in some cases throwing the fumes out from the sides of the canopy.

Mr. D. Williams thought that, if there was already a fair draught, the blocking-up of the fire-place was a matter that should be seriously considered before being carried out. If there was a fair up-draught, and they filled the fire-place in, they would increase the velocity of the air through the fire; and the cold air impinging on the front of the fuel would cool it, so that they would not get any radiant heat at all from it. He thought, therefore, the blocking-up of the fire-place was a course to be resorted to when the draught was sluggish or bad. They must weigh the matter up carefully before finally determining which method to adopt in different cases.

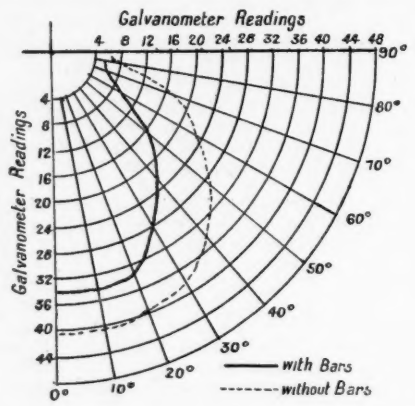
Mr. J. G. Clark, referring to the question of convection *versus* radiation, said he was pleased this matter had been brought forward, because he thought there was a tendency to go to the opposite extreme in endeavouring to do away with convected heat altogether. This, he thought, was quite as bad as the old method, when convected heat formed so large a proportion of the total. Convection, it seemed to him, did add materially to the efficiency of a fire. Of course, it obviously added to its heating effect; but it had another result. It was difficult to describe it; but on a very cold day if one entered a room which was warmed only by radiant heat it took one some time to appreciate the warmth; but if it was warmed in addition by convection—that was to say, the air itself was warmed—the effect experienced was very comfortable and cosy. A trouble, of course, arose in connection with the effect of the heat on the dust; and this could be looked at in two ways. Firstly, the heated surface might be of such a form as to collect dust. In London, dust was always falling; and if it alighted on a flat surface, or anything like a flat surface, it would rest on it, and if it became heated there would be trouble. Secondly, if dust-laden air passed over heated surfaces, the dust in it became burnt. The two effects were not quite the same thing. Obviously, the way to avoid the first trouble was to make the surface in such a style that it would not collect dust. As the dust naturally gravitated downwards, if the surface could be arranged more nearly vertical, the trouble would be at

any rate minimized. Then, with regard to the effect of the heat upon the air, apart from the dust collected upon the hot surface. This was largely a question of temperature; and if the air was not heated above 200° Fahr., he believed the scorching effect on the dust would not be noticed. He had never gone into the question thoroughly; but he was inclined to think the limit was somewhere about 180° to 200° Fahr. If the air was not heated above this, no trouble would be caused. He thought some words of praise should be bestowed on gas-fire manufacturers for the great skill, and thought, and scientific interest they had put into their work during the last few years. They ought not to forget what was due to the makers in this respect.

Mr. D. J. Winslow asked the author if he would give his experiences of cases in which he had chimneys with an excessive draught, and whether he had found it convenient or advisable to make the flue smaller, by having either an adjustable flue or an extension of the idea shown in Diagram No. 4. In one instance, he himself dealt with a poor fire by cutting a slot in the flue, and putting a piece of sheet iron in it to partly shut up the opening; and the result was a good increase in the heat from the fire.

Mr. F. C. Briggs remarked that one point seemed to have been overlooked in connection with convected heat and the blocking-up of the fire-place. This was that for their draught in the chimney they depended entirely on the heat of the products of combustion; and if they had too much convected heat from the stove—if the fire extracted too many of the heat units from the products—they were lessening the power of the products to get away. If they took the whole of the heat out, the air would not ascend. As to the effect of convected heat itself, this was very much a personal matter. He did not like it at all. A room warmed entirely by convected heat seemed to him highly objectionable. The air was dry, and there was a feeling of stuffiness. Mention was made in the paper of the effect of having two anthracite stoves connected with a common flue. He thought this was the general experience with gas-cookers. Where there were two or three ovens ventilating into one flue, it was better to have separate flues, or a flue with divisions in it.

Mr. A. Broadbent said that in regard to the developments in gas-fire construction of late years to which Mr. Browning had referred, he thought it would not be out of place if he mentioned the result of some interesting experiments which he had recently carried out in conjunction with a friend of his—Mr. J. R. Pendlebury, of the South Metropolitan Gas Company. The tests were made with the particular object of ascertaining to what extent the front-bars of a gas-fire affected its radiating qualities. An old-fashioned ball-fuel fire, with deep bars, was used; and after it had got thoroughly hot, readings, by means of a thermopile and galvanometer, were taken at various angles, equi-distant from the centre of the front of the fire, and at a height corresponding with the centre of the incandescent surface, both with and without bars.



The tests revealed the fact that the radiation at the sides of the fire increased very considerably indeed when the bars were removed—out of all proportion to the increased radiation at right angles to the fire—which proved that the new idea of making fires without fire-bars at all was most certainly a step in the right direction. The diagram would show clearly this advantage from an efficiency point of view.

Mr. Browning, in replying to the discussion, said Mr. Ainsworth had referred to an adjustable flue. What he undoubtedly meant was a flue with a controlling valve to regulate the draught. Of course, it was a good idea, if one had always intelligent people to deal with; but his experience of the public was that they were not gas-fitters, and the less they were asked to do in connection with gas heating apparatus, the better it would be. Miss Edden, the Lady Demonstrator to his Company, told him that a great many people were found to grill chops, steaks, bloaters and kippers, &c., on the top of a grill burner of a cooker; and if people were really so stupid as this, and did not know how to grill by the deflector, he was afraid they would not be able to use these regulating valves. They might go to bed one night; and somebody else would find them in the morning. When once a stove was fixed properly and intelligently in position, and the flue draught regulated and controlled, the necessity for the adjustable valve did not arise, because only the heat got away which was requisite for the pull in the chimney, and one obtained from the fire the heat that was wanted. If they used a controlling valve, they were going to increase risks. The best plan was to fix their stoves and regulate their flues so that no accident could happen, without leaving the matter at the mercy of people who might not be sufficiently enlightened to understand and control the regulating valve.

Mr. Ainsworth: I do not mean to put a valve in which will entirely close the flue. I desire to have a maximum and a minimum opening—a very different thing.

Mr. Browning (continuing) said Mr. Larking spoke of using bends instead of elbows. In the great majority of cases a square elbow was just as efficient as a round one. A lobster-backed elbow cost twice as much as a square one; and this had to be considered. Though square elbows were shown in the diagrams, he had used lobster-backs wherever necessary. He did not think they need increase the cost of fixing a fire 6d. unnecessarily, and they would have to get the money back from the consumer. He had made experiments, and had found the difference in velocity between the use of lobster-back and square elbows very small. With the adjustable elbow he had submitted, there would be no need to employ either the square or lobster-back. With reference to the question of side draughts. If they had a circular-fronted fire, and there was a side draught going across the fire, a certain amount of the products of combustion would get into the room; and therefore he was not really fond of this kind of fire. With reference to Mr. Williams's observations as to the effect of filling the in front of grates, everything depended on circumstances—no definite rule could be laid down regarding this. Mr. Winslow referred to excessive draught; and this was a difficulty. Years ago, in his early days, he well remembered coming across a fire the front of which was kept quite cold by the draught playing upon it; and if they held a flame to the convected heat chamber, it was drawn into it. In this case, the top of the chimney was not easily accessible; but if they could get to the top of the chimney, it was an easy matter to control the up-draught, and by fixing the pipe B as in Diagram No. 4 the difficulty was got over at once. As to Mr. Briggs's remarks, some people liked convected heat; others did not. If they dried the air to such an extent as to take out all the moisture, he did not care for it himself; but if they had convected heat so as to give a temperature of not more than 60° Fahr., it would be beneficial. If they took the temperature of rooms which they felt objectionable, they would probably find it was not less than 70° Fahr., perhaps more. He could not work in a room with a temperature of 65° Fahr. He had a gas-fire in his office, and when the heat attained to 65° Fahr., though it was all radiant heat, he had to turn out the fire. The most comfortable temperature he could work in was 60° Fahr.; and whether it was radiant or convected heat, he did not think this would have a very ill-effect on anybody. He thanked them for the attention they had given to his paper, and apologized for its length. The subject, however, was a comprehensive and difficult one to deal with in a small compass.

The President (Mr. L. F. Tooth) remarked that Mr. Browning had dealt with the maintenance of stoves; and this was a point which did not enter into the discussion. He took it the author alluded to a system under which stoves would be periodically inspected in the same way as incandescent lighting. This was a thing which would have to come. The present method of waiting until the consumer complained was a bad one.

Competitive Lighting and Heating Tests at Canterbury.

Reference has already been made to the competitive tests of gas and electric lighting which have been carried out in the window of the show-room of the Canterbury Gas and Water Company, under the direction of Mr. H. C. Page, their Engineer. The results have been given; but it may be mentioned again that in the first series of tests, in which a 50-candle power metallic filament electric lamp and a 60-candle power inverted gas-burner of the ordinary type were used, the difference was 2s. 3½d. in favour of gas. In the second series, a 100-candle Osram metallic filament lamp was set against a 110-candle inverted incandescent gas-burner of the latest type; and the result was exactly 1s. better—the electric light costing 5s. 11½d., and the gas 2s. 7¾d., or a difference of 3s. 3¾d. Some heating tests, extending over 24 hours, have since been carried out; and they form an interesting supplement to the others. The appliances used were a four-tube electric and a five-tube gas-radiator; and the following are the results:

	Area Heated. Cubic Feet.	Increase in Temperature.	Net Cost. s.	d.
Electric radiator	210 ..	12° Fahr. ..	3	0
Gas ,, ...	240 ..	22° ,, ..	0	10
Difference in favour of gas	30 ..	10° Fahr. ..	2	2

In submitting all these results to the residents in Canterbury, by advertisements in the local papers as well as by circular, the Directors of the Company call their attention to the fact that the lighting tests proved conclusively that incandescent gas-burners give more light at less than half the cost of electric light; while the heating tests proved that modern gas-fires give considerably more heat at less than one-third of the cost of electric radiators. They acknowledge that these results were obtained by using the latest designs of appliances; but they point out that they can be repeated in consumers' houses if the burners and fittings generally are brought up to date, as smaller burners are equally efficient.

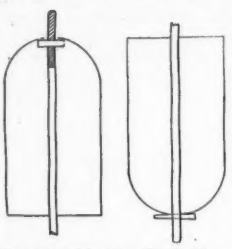
REGISTER OF PATENTS.

Support for Incandescent Gas-Mantles.

UNRUH, MAX VON, of Charlottenburg, Berlin.

No. 30,149; Dec. 24, 1909.

Instead of the mantle being provided with an asbestos cord to be hung on the hooked end of a rod, or (if inverted) bound fast with the broad open end on a holder-ring by means of an asbestos string, the patentee proposes to make the incandescing body with a hole at its apex, and to support it a rod is passed through and "provided with removable devices, on which the body rests." As such removable devices, a screw nut, a fastening pin passed through a hole in the rod, or a collar which can be cemented to the rod in such a manner that it can easily be removed again without damaging the rod, may be employed, as shown.



Von Unruh's Mantle Holder.

The arrangement is said to have the advantage that the incandescing body on heating or cooling can expand or contract without resistance; and with inverted lights the arrangement has the further advantage that the fastening of the body to a ring-holder is not necessary, as the nut, the pin, and the collar prevent the body from dropping.

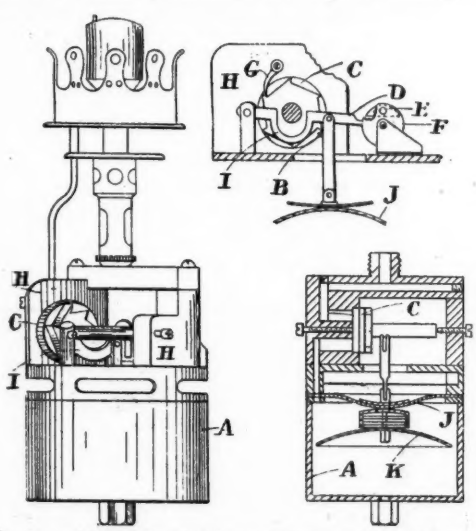
Lighting and Extinguishing Gas-Lamps at Prearranged Times.

BRAZIER, J., and WATSON, H., of Melbourne, Australia.

No. 30,383; Dec. 29, 1909.

This invention is intended to provide means whereby gas-lamps may be lighted and extinguished by mechanism actuated by the rise and fall of the pressure in the mains—particularly to the class of apparatus in which a diaphragm (or its equivalent) is acted upon by the varying pressures to actuate means, rising and falling with the diaphragm, to turn a rotary disc-valve having ratchet teeth that are engaged by a pawl or the like attached to the diaphragm mechanism.

A general view is given of the apparatus attached to a lamp burner; also a vertical section of part of the apparatus, and a front elevation of the valve and retarding mechanism and the pawl mounting.



Brazier and Watson's Lighting and Extinguishing Apparatus.

The chamber A, attached to the gas-main, has a cover or lid bored out on the top to permit of the movements of parts contained within the chamber being conveyed to the disc C of the valve. The disc is held between centres, which permit of its being nicely adjusted and easily removed for cleaning. It is furnished with ratchet teeth, by means of which the valve is operated by a pawl B attached to an arm on the horizontal lever I, which is articulated to a connecting rod attached at its lower end to a horizontally mounted diaphragm J secured to the cover of the chamber A. Below the diaphragm, and suspended from it, is a plate K, which serves the twofold purpose of assisting to baffle solid particles of foreign matter contained in the gas and to support the weights added or subtracted according to the pressure of the gas at the lamp to be operated. The weights are contained in a dome-shaped chamber which presents a convex surface to the underside of the diaphragm.

In operation, gas enters the chamber A and passes upwards to the valve. At the same time, if the pressure is sufficient, the diaphragm and the parts attached to it will be moved upwards. The valve is set to deliver gas to the lamp when the lighting-up pressure is applied, when the pawl B will engage a tooth of the ratchet-wheel and rotate the disc C. From midnight to early morning the pressure recedes to its lowest point, and the pawl falls below the next tooth. Towards morning the pressure again rises; the effect being to cause the upward movement of the pawl to engage the tooth next above it and to rotate the disc a distance equal to about one-half the pitch of the teeth. This lights the pilot and cuts out the lamp; at the same time bringing the finger D into engagement with a trip E, which prevents the further upward movement of the pawl until the lighting-up pressure is again applied. While the day pressure is on and the pilot chamber is registering, the finger D will be in engagement with the trip E, and the retarding means will operate to prevent gas being supplied to the lamp. The mechanism is such that it may be adjusted according to circumstances whereby the finger will be required to overcome a given weight before the lighting-up pressure causes it to cant over the disc F and to pass it by.

The lamp, after being lit, is free to burn steadily in spite of wide variations in pressure; as, before the pawl can again rotate the disc, the pressure must fall to its minimum, and by so doing lower the pawl below the next tooth.

For the purpose of preventing the backward movement of the valve from any cause, a pawl G is supported upon the cheek H, and engages the teeth of the disc.

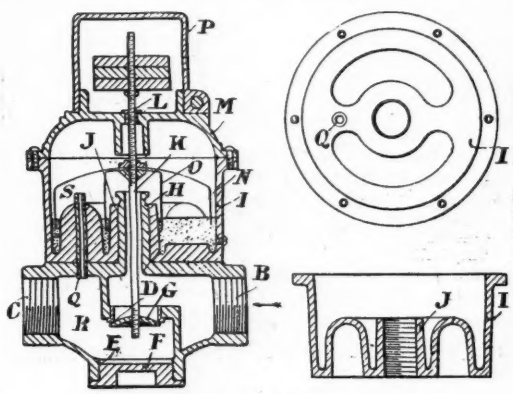
The invention is for use principally upon street-lamps; but if it is to be employed in the lighting of buildings, a governor holder will be installed by means of which the pressure can be turned on or off locally.

Gas-Governors.

LEES, M., of Providence, Rhode Island, U.S.A.

No. 3861; Feb. 16, 1910.

This governor is of the kind which is provided with a continuous annular dome forming a partition between mercury holding grooves into which dips a double bell, the inner bell of which acts as a valve and communicates with the inlet, and the space between the two bells with the outlet—the dome being formed with a channel connecting the two grooves for maintaining an equal height of mercury in them.



Lees's Gas-Governor.

The pipe-connecting base of the governor has the inlet opening B and the outlet opening C; the base being also provided with the valve-seat D. It is further provided with an opening E closed by a removable plug F, whereby access may be had to the valve G whenever required. At its upper side the base has a tubular stem H, exteriorly screw-threaded. The mercury holder I is provided with an annular outer groove and a concentric inner groove with an annular dome or partition between them, and with the upwardly extending hub J, which fits the stem H. The grooves have a connecting passage which extends through the partition, whereby the mercury will be maintained at the same height in both the inner and outer grooves. The valve G is provided with the stem K, which at its upper portion passes loosely through the guide opening L made in the covering dome M, and having at its upper end a weight by means of which the operating pressure of the valve is adjusted. The valve stem K is also provided with the attached outer bell N, and an inner bell O; the bells being caused at their edges to enter the mercury in the outer and inner grooves. The upper end of the valve stem is enclosed by a removable cap P, so that ready access may be had to the valve stem for the purpose of adapting the weights to the pressure required.

When the mercury holder has been screwed tightly to its seat upon the base, the insertion of the tube Q, which forms the connection between the chamber R at the outlet side of the valve and the annular chamber S of the outer bell, serves to prevent the unauthorized removal of the mercury holder. The tube Q extends above the upper surface of the dome partition, so as to prevent an accidental escape of mercury down through the bore of the tube.

Lighting Gas-Burners.

DELAGE, M., and WOOG, P., of Paris.

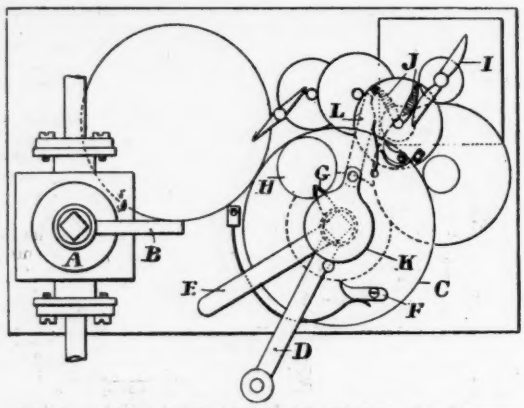
No. 6154; March 11, 1910. Date claimed under International Convention, March 11, 1909.

This invention relates to automatically lighting gas-burners by electricity by the mere turning of a gas-cock. By turning the cock a spring is wound up, whose return movement operates a train of wheels which, after a sufficient period, cause the completion of the circuits necessary for the lighting current.

The apparatus, when worked by means of batteries, fulfils the following conditions: By means of one turn of a key, the gas-cock is opened and the clockwork spring wound up. The clockwork runs down without closing the gas-cock, and after a sufficient period of time momentarily makes contact between the batteries and the different electric

circuits. On the other hand, the gas-cock can be closed by the same key without touching the clockwork.

When ignition by means of a magneto or dynamo machine is required, the movement to be effected consists in winding-up for a suitable number of turns a barrel containing a strong spring, which drives, through a series of multiplying gear-wheels, the electric machine producing the current necessary for lighting and whose unwinding produces the rotation of the machine. The winding-up of the spring has further for its effect to open the gas-cock and set in motion a retarding train of wheels. When the spring is wound up, the barrel (and, consequently, the induction machine) remains stationary—retained by a release controlled by the train of wheels. This train of wheels, on the contrary, is at once set in motion; and its movement is such that it turns for a sufficient time to allow the complete expulsion of the air from the pipe before liberating the release which allows the induction machine to rotate and light the burners. The apparatus shown illustrates one method of construction. The gas-cock A has a key provided with a projection B. C is a barrel containing a strong spring. Its axis carries a winding-up lever D and an arm E, which, when engaging with the arm B, serves to open the cock on the first turn of winding-up. F is the winding-up ratchet of the barrel. G H represent a "Geneva stop"—an arrangement well known in clock mechanism, whose funciion is to limit the winding-up of the spring to a certain number of turns and, consequently, to prevent breakage of the spring. The stop has in this case also the object of preventing the spring (driven by the inertia of the machine) from unwinding beyond the first turn and becoming unhooked. The piece H fixed upon the barrel is provided with a number of notches equal to the number of turns it is desired to make, and bears against the tooth G when the winding-up movement is complete. A similar bearing takes place for limiting the backward unwinding movement.



Delage and Woog's Electric Plant for Lighting Gas-Burners.

The apparatus works as follows: The spring is wound up (by a hand lever) a given number of turns; and by this movement the gas-cock is opened. The tension of the spring is communicated by gearing to the shaft of the induction machine whose cam I, bearing against the cam J, puts the train of wheels into movement. At the end of a period sufficient for the expulsion of air from the pipe, the latter cam has turned through an angle sufficient to allow the release of the cam I, and the liberated induction machine rotates until the spring is unwound, generating the lighting current, which is delivered into the different lighting circuits by the distributor.

In order to again light the burners, it is necessary to replace the cam J into its original position. For this purpose, the spindle carrying it is provided with a pawl allowing rearward movement, which may be effected automatically by several means. For example, the square which receives the hand lever is covered by a plate K furnished with an arm L and a return spring. In the movement of the plate for uncovering the opening, the arm brings the cam J back into its original position. The inclined end of the arm which comes into contact with the cam is mounted upon a helical spring in such a manner that the end passes out of the way when the plate comes back after the key has been withdrawn and no longer bears against the cam J.

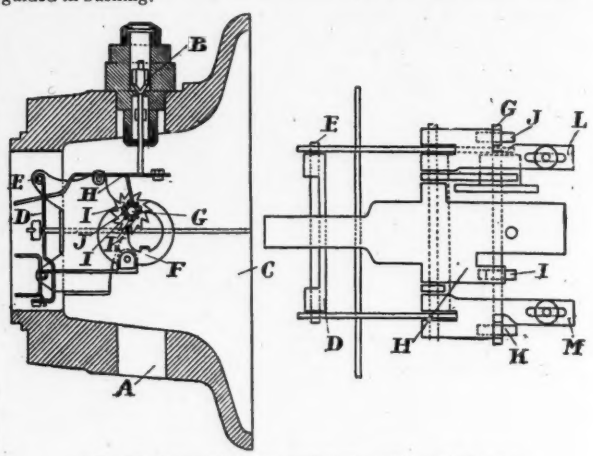
Lighting and Extinguishing Gas-Lamps from a Distance.

OTHMER, E., of Dortmund, Germany.

No. 6786; March 17, 1910. Date claimed under International Convention, March 18, 1909.

In apparatus for lighting gas-lamps from a distance, when actuated by altering or increasing the gas pressure, the patentee says that the grave defect is experienced that the force for actuating the kindling device must be greater than that for extinguishing the lamp—due to the fact that, in extinguishing, the valve is not required to be lifted by the action of the operating force of the gas pressure, but is merely released and allowed to fall freely under the influence of gravity without experiencing any check. It is for this reason that the inventor has devised apparatus for "obviating the said defect," and by means of which the force required for extinguishing is equal to that required for kindling.

Two embodiments of the invention are illustrated. In the first one, the distant kindling device consists of the casing with a gas supply opening A, valve B (which regulates the supply of gas to the burner of the lamp), and membrane C, the oscillations of which (caused by the gas pressure in the casing) are transmitted through a rod adjustable by means of a nut in the first place on to the link D rotatably suspended on the shaft E, and by means of a projection on the end of the lever contacting with a hook transmits the movement to a rod, which, in turn, actuates the escapement F and rotates a toothed wheel on the shaft G. By this means, the lever H, rotatably mounted on a shaft, is lifted and depressed by the cam-wheel I mounted on the shaft G. The valve B rests upon the lever H by means of its stem being vertically guided in bushing.



Othmer's Lamp Lighting and Extinguishing Apparatus.

Now if the lever is lifted by the rotation of the cam-wheel I, the valve B reaches its open position. This establishes the supply of gas to the burner and kindles the lamp. If the flame is to be extinguished, by producing a second oscillation of the membrane the cam-wheel is again rotated, the lever H falls, and with it the valve B. The force required for this operation is, of course, so much smaller in proportion to the weight of the valve. In order to compensate for this difference of force, two additional cam-wheels J K are mounted on the shaft G on either side of the cam-wheel I. These cam-wheels act on two weighted arms or levers rotatable independently; the wheels being staggered relatively to the middle cam-wheel in such a manner that, during the extinguishing of either evening or night lamps, they lift the compensating arms or levers L M, and to do so must expend a certain amount of work which is equal to the work done in lifting the weight of the valve B in the lifting operation. The levers are for this purpose loaded by weights.

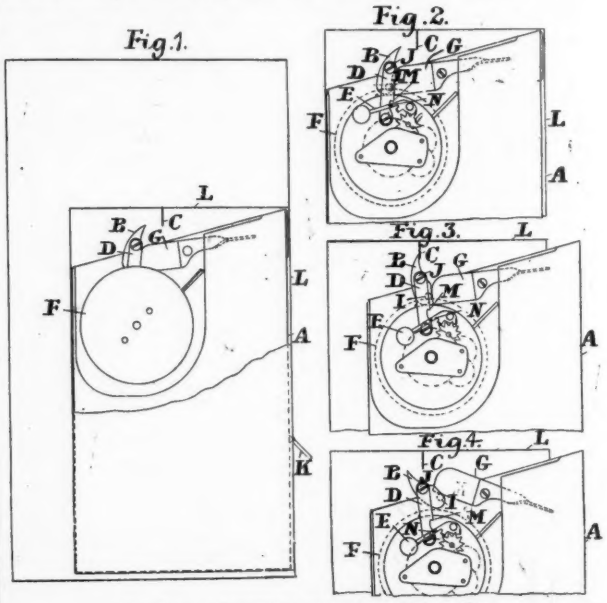
In order that it may be possible to provide for any increased counter force that may be required within certain limits, the weights are adjustable on the ends of the levers in slots. The relative positions of the three cam-wheels I J K determine the times for extinguishing evening lamps, for extinguishing night lamps, and for kindling operation.

Coin-Freed Meter Cash-Box.

HEADING, H. J., and WILLIS, T., of Sydenham, S.E.

No. 6902; March 19, 1910.

This invention takes the form of an alarum, together with a certain mechanical contrivance, fixed in the cash-box in such a manner that, even if the lock securing the box be forced, the box cannot be removed, nor the money extracted, without the alarum being set ringing.



Heading and Willis's Coin-Meter Money-Box.

Fig. 1 shows the cash-box A inserted in its case L, which forms part of the meter, and may be withdrawn from it by means of the handle K. Fig. 2 shows the position of the mechanism in detail. When the cash-box is partly withdrawn, as in fig. 3, the pawl B is brought into contact with the catch-plate C (which is part of the meter case). The pawl is thus prevented from moving by the pin I, which is attached to

it, pressing against the end of the hand lever. The effect of this is to throw the lever D sufficiently far back to disengage the shoulder N of the escapement lever E from the recess M, and cause the spring alarum bell to ring continuously.

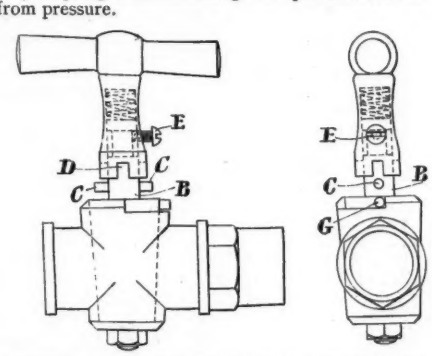
The cash-box A cannot be further withdrawn until the hand lever G is raised, by inserting the finger into the space formed by the partly opened drawer, into the position shown on fig. 4—thus allowing the pin I to pass under the hand lever G. The pawl B, having been released by this lever, will now pass the catch-plate C, and allow the cash-box to be completely withdrawn and its contents removed.

Gas and Water Taps.

FLETCHER, RUSSELL, AND CO., LIMITED, and T. W. FLETCHER, of Warrington.

No. 13,365; June 2, 1910.

This tap is of the class in which the handle or key is automatically prevented by a spring from actuating the spindle when the handle is relieved from pressure.



Fletcher, Russell, and Co.'s Tap for Gas or Water.

The invention consists in making the spindle B round, with a stud C projecting at its base. The upper portion of the spindle (inserted loosely in the handle) is formed with a recess. The shank of the handle is hollow, so as to slide on the stem; and the bottom end of the shank is slotted at D. A spring is placed in the inner end of the shank, so as to press on the top of the stem, and thereby keep the handle normally in a raised position, but is prevented from being withdrawn from the stem by the screw stud E, which is passed through the shank and projects into the recess. When the tap valve is required to be opened, the handle is pressed down until the stud C enters the slots D. The spindle can then be turned as far as the ordinary stop G will permit, when, if the hand is released from the handle, the shank will rise and be disengaged from the stud C by the action of the spring, but cannot be withdrawn from the spindle.

Incandescent Mantles.

SKRIWAN, E., of Vienna.

No. 19,073; Aug. 13, 1910. Date claimed under International Convention, Aug. 13, 1909.

This inventor proposes to support the incandescent mantle along the inner face of the carrying ring or along the outwardly inclined inner faces of supporting rings without the use of threads and grooves by "fritting"—that is, applying to the inner face of the supporting ring (before suspension of the unburnt fabric) substances which easily frit in the heat, such as magnesia, or the like—and thereupon hardening the impregnated fabric so that the inner face of the ring is also contacted by the flame.

APPLICATIONS FOR LETTERS PATENT.

1179.—BONE, W. A., WILSON, J. W., and M'COURT, C. D., "Furnaces." Jan. 17.
1190.—DORWALD, G. L. M., "Burners for seasoning mantles." Jan. 17.
1241.—HUMPHREY, H. A., "Compressing and utilizing gases." Jan. 17.
1243.—KITTLE, H. A., "Use of oil gas." Jan. 17.
1280.—MARTIN, W., "Atmospheric burners." Jan. 18.
1281.—GRAFTON, W., "Gas-injector." Jan. 18.
1312.—CROSSLEY, K. I., and COSTER, A. V., "Production of power by combustible charges." Jan. 18.
1313.—FABRY, R., "Cooling coke-oven gas." Jan. 18.
1341.—AUBERT, A. M. & J. M., "Igniting and extinguishing gas." Jan. 18.
1350.—GOODMAN, L. H., HUNT, A. C., and BOOTH, J. E., "Gas-generators." Jan. 18.
1360.—BALE, W., and HOPKINS, L. H., "Igniting devices." Jan. 18.
1389.—KEY, W., "Petrol-gas plant." Jan. 19.
1448.—POERNER, R., "Gas-stoves." A communication from C. Ehmcke. Jan. 19.
1456.—GALVAO, M., "Atmospheric burners." Jan. 19.
1469.—PROVINCIAL INCANDESCENT FITTINGS COMPANY, LTD., and WEBBER, J., "Inverted incandescent burners or lamps." Jan. 19.
1508.—HACKING, R., and HILL, H. W., "Igniting gas-lamps." Jan. 20.
1518.—DREAPER, W. P., "Treatment of gases." Jan. 20.
1606.—TINLINE, W. J., "Cut-off valve for gas-pipes." Jan 21.
1620.—PODMORE, A. E., "Gas-lamps." Jan. 21.
1645.—FOLLIET-MIEUSSET, A., "Gas-furnaces." Jan. 21.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Some Aspects of Pressure.

SIR,—Your report of my remarks, at the meeting on the 21st inst. of the Yorkshire Junior Gas Association, after Mr. Cranfield's admirable address, on "Some Aspects of Pressure," scarcely conveys a just idea of what I meant to say. Perhaps this is partly due to Mr. Booth misquoting some of my expressions in his address.

In the first place, I did not object to the kinetic theory in its essentials, so much as to the claims put forward on its behalf as a working theory to explain problems of pressure.

It seems to me quite as easy to conceive of "A host of angels, very thin, dancing together on the point of a pin," as one of our poets puts it, as to imagine seventy millions of particles in the space of a pin's head separated from one another by intervals enormously greater than the particles themselves, and yet all jigging about at the rate of one mile per second. And I do not see how such a conception can conduce to clearness in understanding the vagaries of gas pressures. It is difficult enough to think of a million cubic feet of gas in a holder, with its various constituents, and its complexities of character "stratified" or otherwise. But only a kinetic mind can grasp the notion of there being 2000 million million particles actively jostling each other all the time in order to raise the holder or to fill the town mains.

Then, respecting the effect of heat on pressure, my questions were: Is heat merely motion, as some assume? Is it ether, as others assert? Or does it in some way occupy space, or, in conjunction with matter, merely cause the mass to expand, and thus, in the case of gas, cause pressure?

Take an india-rubber bag, and fill it with gas at a pressure (say) of 1 inch. Then subject it to heat; and you will find the pressure rise to 2 inches or more—the volume being increased with the increase of pressure.

Further, with reference to the gas in the retort, I did not take exception to the statement that the gas issued from the retort at a lower temperature; but what I wished to know was, at what temperature the gas is in the retort, if it does not approximate to that prevailing there. I certainly never thought, nor meant, that gas in an ascension pipe is red hot.

Lastly, I do not prefer to state the value of high-pressure incandescent lighting at per square inch of mantle surface. What I pointed out was that the higher value per cubic foot of gas is partly due to the fact that the mantle material responds to the higher flame temperature; and this factor ought not to be ignored in explaining how the additional value is obtained. Quite recently one of our consumers came to inquire why we did not let him have gas at a high pressure for his flat-flame burners, as a scientific friend had told him he would get a much higher illuminating value at his burners.

What I suggested to Mr. Cranfield was that it would be better not to speak of high-pressure lighting, but to call it what it is—high-pressure incandescent lighting.

York, Jan. 28, 1911. J. H. HILL.

Gasholder Construction.

SIR,—I crave your editorial indulgence for an opportunity of rectifying a mistake in my paper delivered at Glasgow on the 14th inst., and published in your columns the following Tuesday.

In my paper there is a paragraph [p. 167 of the "JOURNAL"] quoted from a recent paper by Mr. T. H. Robinson, relative to the strains in the top curb of a gasholder. Through an inadvertence on my part, I am afraid I must have conveyed the impression that Mr. Robinson was the author of the passage alluded to. If such an impression has arisen, I take this opportunity of rectifying my mistake. The passage is practically a verbatim quotation from a paper written in 1882, by Mr. F. S. Cripps. The paper appeared in the Transactions of the Gas Institute for that year. Mr. Cripps has kindly drawn my attention to my inadvertent mistake; and at his request I publish this acknowledgment.

Thanking you for the opportunity given me,

Glasgow, Jan. 27, 1911. JOHN TAYLOR.

Mr. Marshall on Ammonia Recovery.

SIR,—In your report of Mr. Marshall's lecture, on "Ammonia Recovery," in your issue of Jan. 10, the following figures for the projected installation are given: Repairs, at 2s. 6d. per ton of fuel gasified, £2613; fuel, breeze, and slack for producer, £7311; fuel, for boiler—5766 tons of slack, at 12s., £2964. From these, it is easily computed that 20,904 tons of fuel were to be gasified; and that it would cost 7s. per ton.

The lecturer also states that as the amount of breeze was limited, a mixture of 22 to 23 tons at 5s. per ton with 37 to 38 tons of slack at 12s. a ton, was to be used in the producer per day. This mixture, at these prices, would cost 9s. 4d. per ton, instead of 7s., as calculated from the above quantity and total cost. That the quantity of coal is correct is confirmed by the sulphate of ammonia recovered—namely, 80 lbs. per ton.

Further, in the item of boiler fuel, 5766 tons at 12s. would cost £3460, and not £2964, as given in the estimate.

Before setting out to capture the "Elusive Pimpernel," nitrogen, I think it would be well if Mr. Marshall would "clear the decks" by correcting his balance-sheet.

Sheffield, Jan. 17, 1911. JOHN IMRIE.

Meunier's Hydraulic-Main Floats.

Mr. W. Cranfield writes as follows with reference to the editorial remarks on his address to the Yorkshire Junior Gas Association in last

Tuesday's "JOURNAL:" "In reply to the query of the last sentence of your leading article, I do know Mr. Meunier's hydraulic-main floats, and had a reference to them on the slip from which I delivered my address—in fact, I had in mind a report on them which you published when I wrote of a recording pressure-gauge attached to a retort-lid. I have a high opinion of them, and hope to see more of their actual working."

LEGAL INTELLIGENCE.

THE COWDENBEATH GAS-SHARE DISPUTE.

Last Friday, the hearing began before the Second Division of the Court of Session of the action by Mr. Alexander Waddell, of Dunfermline, and Mr. Forbes Waddell, of Queensferry, against Mr. James Hutton, in which decree is asked for £1010 damages in respect of an alleged breach of contract. [The previous proceedings were reported in the last volume of the "JOURNAL," p. 729.] As originally laid, the pursuers also sued Mr. G. B. Tweedie, solicitor, the Law Agent for the Gas Company. In the Outer House, Lord Ormidale allowed a proof in the action as against Hutton; but as regarded Tweedie, he dismissed the action, with expenses. Hutton reclaimed.

The LORD ADVOCATE, K.C., on behalf of the defender and reclaimer, said the peculiarity of the case was that the pursuers did not say which article of the agreement the defender was in breach of; and in no plea in law were they informed of the fact that the pursuers were suing for damages for breach of contract. The contract was clearly and fully expressed in a formal document, which showed that the pursuers did not borrow any money from the defender. He was a shareholder in the Company; whereas the pursuers never were, and might never be, shareholders. He had shares, three-fourths of which the pursuers wished to acquire; and they entered into the agreement. There was this fundamental error in the Lord Ordinary's judgment, that he proceeded on the assumption that he was dealing with the relation of debtor and creditor for a money debt. What there was, he submitted, was a pre-emption to the pursuers to acquire the shares; and it was for the Court to say whether or not the pursuers had relevantly averred a breach of the agreement. He submitted that, whether at common law, or under the agreement, there had been no breach of contract on the part of the defender.

Mr. CONSTABLE, K.C., for the pursuers and respondents, said the whole claim was founded upon the position that the shares in question were held in security of advances. It was quite true that they did not pass from the defender to the pursuers, because the arrangement was made that was set forth in the agreement, the object of which, it seemed to him, was to achieve exactly the same result as would have been arrived at if the shares had been first formally registered in the pursuers' names, and then immediately transferred in security, and the transfer registered in the name of defender. Though the shares might be registered in his name, they were, within the distinct recognition of the parties, the property of the pursuers.

At the close of the learned Counsel's address, the Court deferred judgment.

Slot-Meter Robberies with Assault.

At the Abertillery Police Court last Wednesday, George Newberry and Jesse Hinder, labourers, were charged on remand with being found on enclosed premises for the purpose of committing a felony, and also with assaulting a police constable in the execution of his duty. There were other charges against them. The constable described how, when concealed in a lock-up bakery, he saw the accused attempt to break open a prepayment gas-meter. On being discovered, he was knocked down, and the men made their escape. They were, however, subsequently arrested. Evidence was adduced of robberies of 3s. 5d. and 19s. from slot-meters; and Newberry confessed to having been concerned in the thefts. He was sentenced to nine months' and his companion to six months' imprisonment for the larceny, and each to one day for the assault.

Slot-Meter Robberies in Manchester and Bolton.

Giving evidence at the Manchester City Police Court on Saturday in a case of robbery from a prepayment gas-meter in the Ardwick district, Mr. George Jackson, a gas inspector in the service of the Corporation, said that no fewer than 16 similar robberies had taken place within a radius of 100 yards, and all in the previous fortnight. He stated that the method of obtaining entrance to the houses was much the same in each case. Either a piece of wood was cut out of the back door to enable the thief to unbar or unlock it, or an entrance was effected by the use of false keys. So numerous had these robberies become that women in the neighbourhood were afraid to leave their homes. Benjamin Wills, the accused, who could give no settled address, was said to have taken 1s. 10d. from the meter. There were several convictions against him; and he was committed to prison for six months, with hard labour. Owing to the numerous robberies that have taken place from prepayment gas-meters in empty houses, the Gas Committee of the Bolton Corporation have decided to issue handbills offering a reward of 5s. to anyone giving information that will lead to the conviction of any offender. It is suggested that householders might do much to assist the Gas Department by watching suspicious loiterers near empty houses.

In the report of the evidence of Mr. Henry O'Connor at the Kirkcaldy Gas-Works purchase arbitration which appeared last week, it should have been stated that the tests at Coatbridge and elsewhere referred to by him were made with a No. 1 (not a No. 2) burner. In the tests made for the Kirkcaldy Corporation in 1906, he employed a flat-flame burner, the same as was used in the public lamps.

MISCELLANEOUS NEWS.

BERLIN CORPORATION GAS UNDERTAKING.

Report for the Year 1909-10.

The "Journal für Gasbeleuchtung" for the 28th inst. gives extracts from the report of the Administrative Committee of the Berlin Municipality on the operations of the gas-works during the financial year 1909-10. We abstract some particulars therefrom.

The increase in the make of gas over that for the preceding year amounted to 3·4 per cent., which compares with an increase of 5·9 per cent. in the preceding year, and a considerably larger increase in earlier years. The total make of gas amounted to 9,779,500,000 cubic feet, of which 8,625,200,000 cubic feet was coal gas, in the production of which 742,713 tons of coal was used; and 1,154,300,000 cubic feet was carburetted water gas, in the production of which 23,986·8 tons of coke and 6643·25 tons of oil were used. The relatively small increase in the consumption of gas is accounted for partly by the unfavourable industrial position created by the extended use of the inverted burner, with its lower gas consumption, and partly by a general reduction of working hours in factories, due in some measure to the extension of the eight-hour working day. The introduction of the mantle-tax, which has been highly resented by the populace, is also believed to have acted detrimentally to the extension of the use of gas. The number of consumers supplied through ordinary meters has increased by 15,320, as compared with an increase of 14,355 in the previous year; while the increase in the number of prepayment meter consumers has amounted to only 3089, against 4223 in the preceding year. The consumption of gas through prepayment meters amounted to 6·98 per cent. of the total consumption, as compared with 6·84 per cent. in the year 1908-9.

Coal was bought at prices more nearly normal than the high ones which prevailed in the previous year. Native coal, however, continued considerably dearer than English, so that the latter was used to a larger extent than formerly. The fall in the price of coal was attended by a corresponding fall in the value of coke; and consequently the reduced expenditure on coals was offset by lower receipts for coke.

The gas sold amounted to 4626 cubic feet per head of the population of Berlin; but if the gas sold within the city boundary by the Imperial Continental Gas Association is also taken into account, the total gas consumption per head of the population amounted to 5474 cubic feet. The gas consumed for public lighting amounted to 321 cubic feet per head of the population, as compared with 304 cubic feet in the previous year. Prices were lower for coal tar, liquor, sulphate of ammonia, and spent oxide than in the previous year; but better prices were obtained for oil-gas tar, concentrated liquor, and retort carbon.

As a result of the year's working, a net profit was realized of 7,408,473·83 marks (about £363,160), which is 1,093,654·98 marks (about £53,610) more than in the year 1908-9. A new contract has been made with the suburb of Stralau for the supply of gas for public and private lighting for a term of thirty years. Further details of the year's working will be reported subsequently.

BIRMINGHAM CORPORATION GAS UNDERTAKING.

Quarterly Report of the Gas Committee.

At the next meeting of the Birmingham City Council, the Gas Committee will present a report on their proceedings during the past quarter. It furnishes the following particulars.

Among the contracts entered into was one with Messrs. Humphreys and Glasgow for the reconstruction of Nos. 1 and 2 carburetted water-gas plants at the Nechells works for the sum of £4185, and another with Messrs. Samuel Cutler and Sons, Limited, for a bed of Dessau vertical retorts for the coal-testing plant, for £2538. Another contract entered into was with Messrs. Thomas Piggott and Co., Limited, for the repair of one of the gasholders at the Saltley works.

The report proceeds to state that an action has recently been commenced by the Attorney-General (on the relation of Mr. George Loveridge, a manufacturing jeweller in business in Birmingham, but resident in Handsworth) against the Corporation in connection with alleged overdrafts on the banking accounts of the gas undertaking. Instructions have been given to the Town Clerk to defend the action; and every facility has been afforded to the relator and his Solicitor, and also his Accountant (Mr. W. B. Keen) for the inspection of the books of account of the Gas Department. The Committee are advised by eminent Counsel that they have a good case.

Owing to the rapid development of the district, the Committee have had to consider the question of improving the pressures at King's Norton and Northfield; and for this purpose they have laid down a 12-inch high-pressure main to King's Norton. They have also purchased a piece of land for the purpose of erecting thereon the necessary governor-house and dwelling-house for the attendant. The estimated cost of the work is £15,750, of which £12,000 will be for the high-pressure main. In their report submitted to the Council in May, 1909, the Committee stated that they had arranged to lay down a high-pressure trunk main to the centre of the city. The first portion of the work has been completed; and high-pressure gas is now available in some of the central streets for lighting and manufacturing purposes. Numerous inquiries have been received from prospective users; and the Committee are hopeful that high-pressure gas will be extensively adopted. In connection with this matter, the Committee have taken two rooms in Cornwall Buildings, Newhall Street, which have been fitted up as a laboratory for demonstrating the utility of high-pressure gas in the smelting of all classes of metals, case-hardening, brazing, annealing, and other manufacturing operations, and also for lighting.

The Commitee report that as far back as 1906 they commenced an investigation of the rates charged by the Midland, London and North-Western, and Great Western Railway Companies for the conveyance

of coal, coke, and goods to and from the various works of the Gas Department. When the information obtained had been tabulated and the position of the Companies and the Corporation ascertained, negotiations were opened with the Companies with a view to an amicable settlement of the claims of the Corporation in respect of alleged overcharges. After protracted negotiations, a conference was held with the representatives of the Companies concerned, when certain proposals were made by them for the settlement of the differences which existed. The Committee could not see their way to accept these proposals, which were considered inadequate; and the Companies were informed that an application already lodged must be fought out before the Railway and Canal Commissioners. The case was heard by the Commissioners in March, 1909, judgment being delivered by them in the following November. [The matter was recorded in the "JOURNAL" at the time.] The Committee were not successful in reducing the rates charged on their heavy coal traffic; but they obtained considerable reductions in coke and other rates—most of these being made by the respective Companies during the course of the proceedings. After considerable negotiation with the Companies, the order of the Court was sealed in May last. The proceedings resulted in the payment by the Companies to the Corporation of a sum of £3319 7s. 6d. as damages. In addition, the Corporation will in future benefit to the extent of about £772 per annum in respect of rates reduced and economies effected as a result of the proceedings, which the Committee submit have thus been fully justified.

GASLIGHT AND COKE COMPANY'S ACCOUNTS.

[For the Half-Yearly Report, see p. 286.]

The accounts of the Company for the six months ended Dec. 31, to be submitted with the Directors' report on Friday week, consist of the usual statements, from which we take the following particulars.

The statement of capital (stock) sets forth that the total paid up is £10,264,980; added on conversion, £12,697,710—total amount authorized, £22,962,690. Deducting the amount redeemed, £120,880, the total amount of the Company's existing capital powers is £22,841,810. The statement of loan capital stands thus: Total paid up, £3,097,300; added on conversion, £1,564,405; unissued, £750,000—total amount authorized, £5,411,705.

The capital account shows receipts (with premiums, £1,669,476 8s. 5d.) to the amount of £29,172,991 8s. 5d. The expenditure is shown in the following items:—

Expenditure to June 30, 1910		£14,620,116 2 9
Expenditure during the half year to Dec. 31, 1910—viz.,		
Lands acquired, including law charges	£4,697 15 6	
Buildings and machinery in extension of works	11,014 9 7	
New and additional mains and service-pipes	18,431 11 4	
Do. do. meters	25,509 17 7	
Do. do. stoves	39,988 14 2	
		99,642 8 2
		£14,719,758 0 11
By depreciation of plant	£11,797 19 5	
By depreciation of meters and stoves	51,770 16 6	
		63,568 15 11
Total expenditure		£14,656,189 15 0
Nominal amount added on conversion		14,262,115 0 0
		£28,918,304 15 0
Deduct amount of capital redeemed under Company's Act of 1903		120,880 0 0
		£28,797,424 15 0
Balance of capital account		375,566 13 5
		£29,172,991 8 5

The balance applicable to the redemption fund and to dividend on the ordinary stock is £1,013,208 15s.; and the following statement shows how it is proposed to appropriate it:—

Dec., 1909.			
£432,612	..	Net balance brought from last account	£542,370 3 10
444,507	..	Net revenue for the half year	470,838 11 2
£877,119			£1,013,208 15 0
10,000	..	Contribution to redemption fund	10,000 0 0
(£4 13s. 4d. p. ct.)		Dividend on the ordinary stock—	
£377,479	..	£4 13s. 4d. per cent. per annum on £16,179,445	377,520 7 8
£489,740	..	Balance carried to next account	£625,688 7 4

The following statements relate to the working:—

Statement of Coal Used, &c.

Description of Coal.	In Store June 30, 1910.	Received During Half Year.	Carbonized During Half Year.	Used During Half Year.	In Store Dec. 31, 1910.
	Tons.	Tons.	Tons.	Tons.	Tons.
Common	133,210	969,740	870,579	2,002	230,369
Cannel	3,514	..	398	..	3,116
Total	136,724	969,740	870,977*	2,002	233,485

* In addition to this quantity of coal, 6,749,776 gallons of oil were used during the half year.

Statement of Residual Products.

Description.	In Store June 30, 1910.	Made During Half Year.	Used During Half Year.	Sold During Half Year.	In Store, Dec. 31, 1910.
Coke—tons	19,239	553,762	113,782	441,599	17,620
Breeze—tons	545	76,803	9,880	65,347	2,121
Tar, from coal only—galls.	1,163,845	8,633,868	8,201,597	390,742	1,205,374
Ammoniacal liquor—butts	20,946	284,157	278,686	..	26,417

Statement of Gas Made, Sold, &c.

Quantity Made.	Quantity Sold. Public Lights and Under Contracts (Estimated).	Quantity Sold. Private Lights (per Meter).	Total Quantity Accounted for.	Number of Public Lamps.
Thousands.	Thousands.	Thousands.	Thousands.	
*13,602,533	456,210	12,183,365	12,792,178	47,404
†13,158,698	472,027	11,799,697	12,416,411	50,296

* Including 3,165,109,000 cubic feet of carburetted water gas. † Dec. half year 1909.

The three statements relating to the reserve, insurance, and depreciation funds stood as follows on Dec. 31: Reserve fund, £57,887; insurance fund, £191,277; depreciation fund, £75,519.

The remaining statement is the balance-sheet, which gives the value of the stores on hand at the close of the half year as follows: Coal, £149,712; oil and petroleum spirit, £40,376; coke, £11,758; tar and ammoniacal liquor and products, £90,356; and sundries, £245,817. The figures this time last year were: Coal, £180,220; oil and petroleum spirit, £38,913; coke, £4368; tar and ammoniacal liquor and products, £95,416; and sundries, £236,229.

The following is the revenue account:—

Expenditure.

December Half Year, 1909.		£ s. d.	£ s. d.
	Manufacture of gas—		
£530,529	Coal, including all expenses thereon	555,515 1 6	
76,187	Oil ,, less value of oil tar	47,085 3 9	
38,730	Coke and breeze used in the manufacture of carburetted water gas	40,88 17 9	
15,562	Salaries of Engineers and other officers at works	15,572 7 7	
97,185	Wages	97,098 6 11	
12,236	Purification	16,466 0 9	
201,575	Repair and maintenance of works and plant, materials and labour, less received for old materials, £5325 8s. 2d.	206,593 1 10	
	Distribution of gas—		978,819 0 1
50,556	Salaries and wages of officers (including rental clerks)	52,137 5 10	
54,115	Repair and maintenance of mains and service-pipes, &c.	87,241 14 10	
69,303	Repair and renewal of meters	73,943 14 9	
66,282	,, ,, stoves	83,657 17 3	
39,940	Gas fittings, including labour (automatic meter supplies)	33,656 7 9	
			330,637 0 5
21,154	Public lamps—lighting and repairing	..	28,035 9 9
	Rents, rates, and taxes—		
6,119	Rents payable	6,758 9 7	
149,768	Rates and taxes	151,188 11 6	
			157,947 1 1
	Management—		
4,750	Directors' allowance	3,750 0 0	
407	Company's Auditors and Assistant	202 2 0	
10,025	Salaries of General Manager, Secretary, Accountant, and clerks	9,819 11 7	
25,521	Collectors and cashiers	26,059 0 3	
7,733	Stationery and printing	6,762 6 5	
6,695	General charges	6,716 15 3	
			53,309 15 6
13,000	Co-partnership for the half year	..	16,000 0 0
2,087	Parliamentary charges	..	668 18 5
1,273	Law charges	..	1,324 15 5
..	Charges *re* Quinquennial re-valuations	..	900 0 0
8,657	Bad debts	..	8,454 7 5
500	Depreciation fund for works on leasehold lands	..	500 0 0
26,462	Annuities to officers and workmen, including contribution to officers' superannuation fund	..	27,027 5 2
1,886	Workmen's compensation account	..	2,234 17 2
12,000	Stamp and conveyance duties	..	..
	Public officers—		
873	Gas Referees and Official Auditor	856 5 0	
651	Public testing-stations	772 16 1	
			1,629 1 1
£1,551 761			1,607,487 11 6
663,675	Balance carried to net revenue account		691,835 3 2
£2,215,436			2,299,322 14 8

Receipts.

December Half Year, 1909.		£ s. d.	£ s. d.
	Sale of gas—		
£1,572,429	Per meter, at 2s. 8d. and 2s. 2d. per 1000 cubic feet	1,579,978 3 0	
75,733	Public lighting and under contracts	68,229 14 4	
			1,648,207 17 4
£1,648,162			
35,385	Rental of meters	..	66,180 2 4
53,860	Rental of stoves	..	55,017 19 6
80,620	Rental of fittings	..	65,111 14 5
	Residual products—		
£244,912	Coke, less £34,656 11s. 1d. for labour, &c.	286,540 19 11	
20,529	Breeze, less £7215 6s. 11d. ,,	19,312 9 8	
42,919	Tar and tar products	55,268 2 7	
84,061	Ammoniacal liquor and sulphate of ammonia	57,848 13 2	
			458,970 5 4
£392,421			
£4,672	Rents receivable		5,520 8 3
316	Transfer fees		314 7 6
£2,215,436			2,299,322 14 8

A suite of special and other large gas apparatus has been supplied by the Richmond Gas Stove and Meter Company, Limited, for use at one of the principal hotels in China.

SOUTH METROPOLITAN GAS COMPANY'S ACCOUNTS.

[For the Half-Yearly Report, see p. 286.]

The following are the principal portions of the accounts of this Company for the six months ending the 31st of December.

The first two statements relate, as usual, to the stock and loan capital. The former sets forth that the standard rate of 4 per cent. is payable on £6,011,224 and £418,671 (Act of 1901) of stock; while the latter shows that the loan capital, the rate of interest on which is 3 per cent., amounts to £1,798,994 and £96,451 (Act of 1901). The third statement is the capital account. It stands as follows: Amount received, £5,328,820; nominal amount added by conversion (less premium), £2,996,520—total, £8,325,340. The items of expenditure are as follows:—

Capital account to June 30, 1910			£5,067,008 13 3
Expenditure during half year to Dec. 31, 1910, viz.—			
New and additional mains and services	£1,423 9 10		
New and additional meters	816 8 0		
New and additional stoves	1,238 16 7		
		3,478 14 5	
Total expenditure			£5,070,487 7 8
Balance			258,332 12 4
			£5,328,820 0 0
Nominal amount added by conversion, less premium			2,996,520 0 0
Total			£8,325,340 0 0

The following is the revenue account:—

Expenditure.

Manufacture of gas—			
Coal into store	£340,203 4 7		
Purification	15,230 0 8		
Salaries of Engineer and Officers at works	14,313 8 9		
Wages (carbonizing)	44,774 18 6		
Repairs and maintenance of works and plant, less £6033 8s. 4d. received for old materials	131,526 12 7		
		£516,048 5 1	
Co-partnership		16,000 0 0	
Distribution of gas—			
Repair, maintenance, and renewal of mains and service-pipes	£32,024 6 8		
Salaries and wages of officers, including rental clerks	19,946 13 10		
Repairing and renewals of meters	26,404 6 7		
Repairing and renewals of stoves	39,694 4 2		
Repairing and renewals of gas-fittings	51,037 0 8		
		169,106 11 11	
Public lamps, labour and materials £20,645 7s. 7d., less £14,824 7s. 1d. received for the same		5,821 0 6	
Rents, rates, and taxes—			
Rents payable	£1,157 18 3		
Rates and taxes	44,755 10 1		
		45,913 8 4	
Management—			
Directors' allowance	£2,837 15 0		
Salaries of Secretary, Accountant, and clerks	3,790 15 7		
Collectors { Ordinary	5,674 8 10		
Collectors { Slot meter	9,675 15 0		
Stationery and printing	3,030 15 7		
General charges	10,978 7 5		
Company's Auditors	112 10 0		
		36,100 7 5	
Law charges	£1,793 11 8		
Parliamentary charges	423 5 5		
		2,216 17 1	
Bad debts		1,926 4 3	
Stolen from 4360 slot meters broken open		441 4 8	
Pensions and officers' and workmen's superannuation, sick, and accident funds		6,562 9 8	
Gas Referees and Official Auditor		241 0 8	
Total expenditure		£830,377 9 7	
Balance carried to net revenue account		199,996 14 11	
		£1,030,374 4 6	

Receipts.

Sale of gas—			
Michaelmas, at 2s. 2d. per 1000 feet	£267,397 10 10		
Christmas, at 2s. 2d. per 1000 feet	375,615 5 3		
	£643,012 16 1		
Public lighting	17,214 11 6		£660,227 7 7
Meters in use (354,357)—			
Company's meters at rent: Ordinary, 96,683; slot, 249,629	£39,422 18 5		
Company's stoves at rent: Ordinary, 78,773; slot, 203,107; fires, 29,489	31,062 19 10		
		70,485 18 3	
Residual products—			
Coke, less labour and cartage	£160,059 13 11		
Breeze, less labour and cartage	3,870 16 1		
Tar and tar products, less labour	31,392 17 4		
Sulphate of ammonia ,, ,,	61,306 6 2		
		256,629 13 6	
Rents receivable		1,526 6 9	
Transfer fees		84 2 6	
Fittings		41,420 15 11	
Total receipts		£1,030,374 4 6	

Total amount paid in salaries for half year, £38,436 13s. 4d.
,, ,, ,, wages ,, £287,302 6s. 5d.

The net revenue account shows a sum of £260,959 16s. 9d. applicable to dividend on the ordinary stock. Following this are the statements relating to the reserve, renewal, and insurance funds. They show that the balances on Dec. 31 were as follows: Reserve fund, £186,930; renewal fund, £31,279; insurance fund, £97,100. The following statements relate to the manufacturing operations of the Company:—

Statement of Coal.

In Store June 30, 1910.	Received During Half Year.	Carbonized During Half Year.	Used During Half Year.	In Store Dec. 31, 1910.
Tons.	Tons.	Tons.	Tons.	Tons.
104,523	696,749	555,680	1,014	244,578

Statement of Residual Products.

Description.	In Store June 30, 1910.	Made During Half Year.	Used During Half Year.	Sold During Half Year.	In Store Dec. 31, 1910.
Coke—cwt.	136,580	6,874,006	1,788,719	5,021,327	200,540
Breeze—yards	6,777	113,228	51,658	60,748	7,599
Tar—gallons	373,408	5,395,188	5,299,339	28,345	440,912
Ammoniacal liquor—butts	6,804	201,866	195,927	..	12,743

Statement of Gas Made, Sold, &c.

Quantity Made.	Quantity Sold.		Total Quantity Accounted for.	Number of Public Lamps.
	Public Lights (estimated).	Private Lights (per Meter).		
Thousands.	Thousands.	Thousands.	Thousands.	
6,681,496	193,754	6,108,992	6,374,576	24,258 incandes't 8 flat-flame

The remaining statement is the balance-sheet, which gives the value of the stores in hand at the close of the half year as follows: Coal, £149,567; coke and breeze, £7247; tar, sulphate, and ammoniacal liquor, £39,960; and sundry plant and stores, £310,592. The figures this time last year were: Coal, £136,358; coke and breeze, £5672; tar, sulphate, and ammoniacal liquor, £43,955; and sundries, £298,946. A sum of £33,591, workmen's bonuses and savings, has been deposited with the Company; and the total of the officers' superannuation and guarantee funds is £53,903. The figures last year were £15,123 and £52,149.

DEMURRAGE CHARGES ON SCOTTISH RAILWAYS.

On Monday last week, the Railway and Canal Commissioners, sitting in Edinburgh, gave their decision in an inquiry they conducted for several days last October and November into a dispute between the three principal Railway Companies in Scotland—Caledonian, North British, and Glasgow and South-Western—and the traders on their systems, over the question of demurrage. In August, 1908, the Companies issued a circular intimating that, on and after Feb. 1, 1909, certain demurrage charges in respect of detention of waggons, sheets, and siding-rent would be put in force. The charges proposed to be levied were: For each waggon of any capacity not exceeding 16 tons, 1s. 6d. per day or part of a day; exceeding 16 tons and up to 20 tons, 2s. per day or part of a day; exceeding 20 tons and up to 30 tons, 3s. per day or part of a day; and for waggons exceeding 30 tons capacity, 5s. per day or part of a day. Sheets were to be charged at the rate of 6d. per day or part of a day, and siding-rent was to be at the rate of 6d. per waggon per day or part of a day. The Companies also maintained that they held the right to limit the number of private waggons which might be put upon their system for trading purposes. The result of the inquiry is that the above-named demurrage charges for waggons are allowed, and sheets are to be charged 3d. per day or part of a day; but the free time given for loading and unloading has been extended. Ordinary traders are to have one clear day for loading, and four, instead of two, clear days for unloading, before demurrage is charged. Colliery owners are to have two days instead of one for loading coal intended for shipment; and four clear days for unloading it. Coal merchants are also to have four clear days for the unloading of waggons at stations or depôts. With regard to the use of private waggons, the traders claimed an absolute right to have their minerals or goods conveyed in their own waggons. This claim has not been allowed, chiefly on the ground that the Companies have provided an ample supply of waggons for their traffic, and the Commissioners think that it is reasonable that customers should be required to use them as far as possible.

Commenting upon the decision last Friday, the "Iron and Coal Trades Review" said: "There are grievances on both sides; and certainly the decision will entail some hardship, especially on the smaller collieries. There has undoubtedly been undue detention in many cases during past years; but it has not always been due to the traders, as frequently the Railway Companies were unable to deal with their traffic expeditiously, owing chiefly to the lack of locomotive power. This resulted frequently in collieries being thrown idle for want of the necessary supply of empty waggons; and, in addition, ships were detained by the slowness of the Companies in forwarding loaded waggons. Regarding the privately-owned waggons, it should not be forgotten that colliery owners have invested a great deal of capital in rolling stock, with the direct approval of the Companies themselves; and it would be unreasonable if they were now denied the proper use of these waggons. The Railway Companies will have to be cautious in the use of their powers, as they may find that a rigid insistence on their claims will bring them more loss than gain."

As the result of a fire last Tuesday night at Messrs. R. & W. Paul's grain stores and elevator at the dockside at Ipswich, the electric light mains were fused, thus giving rise to a good deal of inconvenience. In the course of an interview with a local pressman, Mr. Frank Ayton, the Chief Engineer at the electric light works, remarked that it was not at all a frequent occurrence, and was caused by the falling of great masses of red hot *débris* just over the place where the main was. Tons of it must have come down; and as the main was situated near where the elevator fell, it was affected. The result was a short-circuit, and the disconnection of the district. This happened about 11.15 p.m. As soon as possible, a good supply was re-established. Everything was speedily put right, except, of course, the main along the dock. Nothing could be ascertained as to the damage to the main until the wreckage was cleared away. Luckily it all happened late in the evening, when fewer people were using the light than at other times.

GAS CHARGES AT SALFORD.

Suggested Town's Meeting and an Investigation.

Mr. Purcell, one of the Labour members of the Salford Town Council, has given the Town Clerk notice of the following resolution which will be moved at the next Council meeting: "That the slot-meter users have remitted to them an amount equal to the difference between 27 and 30 cubic feet of gas per penny charged during the period over which the meter-rents were charged, and since resolved by the Gas Committee to be remitted." Meetings are being held in different parts of the borough to protest against the present gas charges made to all classes of consumers. The first took place last Friday night, in the John Street Hall, Pendleton. The principal speaker was Mr. Purcell, who declared that the prices charged for gas by the Corporation were too high, and urged the need for thorough investigation being made in regard to the administration of the gas undertaking of the borough. He contended that if, instead of devoting such large sums annually towards the relief of rates, they had adopted the policy of setting aside the money for depreciation, interest on loans, &c., they would not have the existing tremendous debt hanging over them to-day. and they would be having cheaper gas. The following resolution was declared to have been carried unanimously: "That this meeting of users of gas, resident in the borough of Salford, emphatically protests against the present gas charges, both for prepayment and ordinary meters; and further resolves that a petition be signed and presented to the Mayor of the borough, urging the immediate necessity of holding a town s meeting to consider the question."

PADIHAM GAS FOR HIGHAM.

Local Government Board Inquiry.

The Padiham Urban District Council having made an application to the Local Government Board for a Provisional Order to sanction the supply of gas to Higham, Mr. R. C. Maxwell, one of the Board's Inspectors, held an inquiry into the matter at the Padiham Council offices last Tuesday. Mr. J. C. Waddington, the Clerk of the Council, appeared in support of the application; Mr. J. C. Pollard attended on behalf of the Higham Parish Council. Among those present were Mr. Riding, the Chairman of the Gas Committee, and Mr. A. J. Harrison, the Engineer and Manager.

It was stated by Mr. Waddington that, by virtue of the Padiham Urban District Council Act, 1908, the Council were empowered to supply gas to Sabden; and this had been done. Higham now desired to have a similar supply of gas; and the Padiham Council were seeking a Provisional Order to furnish it on exactly the same terms. The estimate of cost in regard to Sabden had proved correct; and the results were likely to be somewhere about what the Engineer had expected them to be, and they were satisfactory to the Council.

Mr. Harrison said the estimated cost of the supply to Higham would be £800; and he anticipated that there would be a demand for some 1,575,000 cubic feet of gas per annum.

Mr. Calderbank, the Clerk to the Higham Parish Council, stated that, with one exception, the property-owners were in favour of a supply of gas; and the gentleman who was the exception had since stated that he was willing, if his tenants desired it, to put in gas. The township population was 700, and that of the village about 500. About 130 circulars were sent out in the village, and 125 had been returned. Of these, 93 were in favour of gas, 23 against it, and 9 were neutral; and some of those who had been against or neutral had since intimated their intention of taking gas.

The Chairman of the Parish Council, Mr. Dyson, said he thought everybody would take gas if it were brought into the village.

OPPOSITION TO THE MARGAM GAS BILL.

Points for the Ratepayers' Consideration.

In the "JOURNAL" last week (p. 243), a report appeared of a meeting of ratepayers in the area of the Margam Urban District Council, at which considerable opposition was shown to the proposal of the Council to promote a Bill to enable them to purchase from the Aberavon Corporation the right to light the district by gas, for which it is proposed to erect works in Port Talbot. At the close of the meeting, which was a rather noisy one, a resolution sanctioning the promotion of the Bill was declared to be carried; but a poll was demanded, and a petition, signed by 120 ratepayers, has been presented to the Chairman of the Council.

A statement has been issued to the ratepayers, in the course of which several points have been submitted for their consideration. In the first place, it appears that the Parliamentary Agents of the Council have expressed the opinion that probably Parliament would not approve of the division of the Aberavon gas undertaking, and, even in the unlikely event of their doing so, the price that would have to be paid in consequence of the severance might be heavy, as the Corporation would be left with gasholders and manufacturing plant far in excess of their needs. All this would have to be taken into account in fixing the price to be paid; and this would have to be such as to compensate Aberavon for the loss by severance, and for having left on their hands surplus works which they would not require for many years.

Next, with regard to the proposal of the Council to ask for power to borrow £27,000 for the purchase of the site and the erection of works, it is pointed out that this sum does not include the amount that would have to be paid to the Corporation for the purchase of their gas-mains in the Margam district, nor the compensation to them for loss of profit and works left on their hands. Judging from recent cases of a similar nature, it is thought this might amount to anything up to £100,000. Even assuming it should be only half this amount, the Margam ratepayers would be saddled with repayments of principal and interest amounting to upwards of £3000 yearly. This means a rate of 1s. in the pound for the first year. The following years there would be the income to be derived from the sale of gas, &c., less working expenses, to go towards the reduction of this rate. The income would be regulated by the price charged for gas; and, to obtain any profit at all, the sum of £3000 annually (repayments of principal and interest), and also the working expenses, which could not be less than another £4000 annually, must be cleared. This could not, it is submitted, be done with Margam's present population, nor for years to come at the ordinary increased rate of population. If the ratepayers are willing to pay for their gas 5s. per 1000 cubic feet (the maximum), they would, it is stated, still be saddled with increased rates to wipe off their deficiency. If they are not willing to pay increased rates and a higher price for gas, they are advised to vote against the Bill.

Finally, it is urged that the promotion of the Bill, viewed from any standpoint, is detrimental to the interests of the ratepayers and gas consumers in the Margam district, as, in the natural sequence of events, the price of gas charged by the Aberavon Corporation, if the gas supply is left in their hands, must, in the near future, be still further reduced.

BIRMINGHAM PUBLIC LIGHTING.

Past and Present.

The ceremony of laying the foundation stone of a new depôt for the business of the department which is responsible for the public lighting of the city of Birmingham was performed last Thursday by Alderman Sir James Smith, the Chairman of the Public Works Committee, in the presence of the Lord Mayor (Alderman Bowater), the members of the Committee, and a number of officials. The old depôt was purchased by the Great Western Railway Company for £12,000; and this sum was sufficient to enable the Public Works Committee to buy the freehold of a site for a new depôt in Cambridge Street, and erect and equip the necessary buildings. The site secured has an area of 2300 square yards; and when finished, the depôt (to the designs of the City Surveyor, Mr. H. E. Stilgoe) will be not only self-contained, but complete in every particular. The ground floor is to be appropriated to the uses of a general store, various shops, rooms, and offices, with stabling and coach-house and the necessary apartments for harness and stores. On the first floor will be the testing-rooms, carpenter's shop, timber store, and clerical department; and above this storey is to be built a long workshop. When laying the stone, Sir James Smith was presented with a mallet by the builder (Mr. S. F. Swift); and after the ceremony, the company adjourned to the Queen's Hotel, where Sir James Smith entertained them at luncheon.

Proposing the health of the Lord Mayor, Sir James Smith said that, like many of their present municipal undertakings, the Public Works Lighting Department began in a very small way. About 150 years ago, an attempt was made to pass an Act called the Lamp Act, the object of which was to light Birmingham with candles. This was opposed, as many other things were opposed; for they could always find some people in Birmingham who would oppose every improvement. However, the Act was passed; and the Lamp Department began with half-a-dozen lamplighters. To-day they had 137; and the number of lamps had grown from a few dozens to 14,500 at the present time. The department commenced with ordinary candles; but to-day they had in Corporation Street and in other parts of the city lamps of 1000-candle power, while at the bottom of Corporation Street they had one column with two lights each giving 3000-candle power. In 1829, Birmingham was lighted by gas for the first time. He did not know what the price of gas was per 1000 cubic feet; but twenty years later, in 1849, the cost was 6s. 8d. per 1000 cubic feet. The next improvement in gas lighting was the replacement of the old burners by incandescent mantles; and now, last of all, they had high-pressure lamps in the centre of the city. He thought the public lighting of Birmingham had given very great satisfaction; and he could not help reflecting that the department was the only one that had not been criticized in the Council Chamber. They all recognized how well the City Surveyor had organized the department; and they congratulated the Superintendent of the Lighting Department (Mr. J. Green) on the admirable manner in which the work was performed.

In reply, the Lord Mayor remarked that the site of the new Lighting Department was connected in a way with the discovery of coal gas. In 1792, Murdoch discovered the illuminating power of coal gas; and he used to have a hand-lamp supplied with gas carried in a bladder under his arm. In 1819, a Company was formed for the manufacture of gas; and some few years later they received an order from the Street Commissioners for about 220 public lamps. It was not until 1827 that meters for measuring gas were first used; and it was in 1841 that the Public Works Committee undertook the general lighting of the city by gas. At first, 700 lamp-columns were ordered, but now 14,500 were in use. In 1851, a petition was presented to the Corporation to buy the gas-works; but it was not until a quarter-of-a-century later that Birmingham, through the influence of Mr. Chamberlain, acquired the undertaking. In 1790, about the time of the discovery of coal gas, which was then spoken of as inflammable air, about 7 acres of land were purchased by a man named Norton, on a lease for 120 years, at a ground rent of £155 10s. This land afterwards became the site of Cambridge Street and the Crescent; and the portion of land on which the lighting depôt was being erected for the Corporation had been purchased from the owners of the freehold.

Councillor Martineau proposed "The Officials of the Department," and Mr. Stilgoe, in the course of his reply, asked Sir James Smith to accept two small silver fruit dishes for Lady Smith, as a mark of the esteem in which Sir James was held by the department.

The Town Clerk (Mr. E. V. Hiley) submitted the health of Sir James Smith; remarking that Sir James had been a member of the Corporation for 25 years, and for nearly 20 years he had directed the affairs of the Public Works Committee.

Sir James Smith, responding, said that so long as he had the kindly co-operation of the Committee, he should do all he could to further the work of the department and the interests of the Council.

GAS AND ELECTRICITY IN MANCHESTER.

Conference between the Gas and Electricity Committees.

At the request of the Chairman of the Gas Committee of the Manchester Corporation (Alderman Gibson), a conference with the Electricity Committee was held a short time ago, under the presidency of the LORD MAYOR (Right Hon. Charles Behrens), to consider various matters bearing upon what is regarded as the unfair competition of that Committee with the gas undertaking of the Corporation.

Alderman GIBSON, addressing the Lord Mayor, said he felt that the gas undertaking of the city was suffering very severely from what he considered the unfair competition of the Electricity Committee; and inasmuch as both Committees belonged to the same Corporation, and worked for the same ends—viz., the welfare of the community—he thought such competition was wrong in principle, suicidal in effect, and, if continued, must end in disaster. The speaker gave a sketch of the early days of electricity supply in Manchester. It was introduced in the summer of 1893, when he was Chairman of the Electricity Sub-Committee, with Alderman Higginbottom as Deputy-Chairman and Mr. Wordingham as Electrical Engineer. His two colleagues then allowed their zeal to "run away with their heads;" but the concern was a young one and must be supported. They had only to ask for money from the Council and get it. He objected to such lavish expenditure upon a prospective business; and he relieved himself of all further responsibility by asking the Council to make the Electricity Sub-Committee one of the Standing Committees. This was done early in 1897. Mr. Wordingham left about this time, and was succeeded by Mr. Metzger. This gentleman went a great deal faster than his predecessor; the consequence being a rush into a tremendous expenditure of money and a most expensive plant for an entirely prospective business. Already a large sum had been spent on the Stuart Street station, £50,000 on a railway to carry coal to it, and £20,000 to distribute it when it got inside. There were 22 transformer stations, each of which cost, he believed, £22,000, when they could, in his opinion, have been built equally well for £10,000. He was not blaming any member of the present Committee for this, but only trying to show what led up to the ruinous policy, as he thought, which they felt called upon to adopt—that of selling current at less than its cost—in order to find work for the excess of machinery they possessed. In 1899, the capital account of the Committee was, in round numbers, £500,000—no mean capital for so young a concern. Their net profit then was £17,000, or 4 per cent. on this capital. Next year they had increased it to £650,000; and the net profit represented less than 2 per cent. In 1901, they had raised their capital to £863,000; and their net profit showed less than 1 per cent. In 1902, the capital had gone up to £1,164,000; and the net profit again was less than 1 per cent. He did not wish to weary his Lordship with the details of every year since then, which he had taken out of the Committee's own private statements, but would content himself by saying that every year there had been an enormous increase in capital, and an equally deplorable lessening of the return upon it. He must, however, show how the capital account had grown. In 1903, it was £1,713,000; in 1904, £2,110,000; in 1905, £2,200,000; in 1906, £2,267,000; in 1907, £2,385,000; in 1908, £2,489,000; in 1909, £2,568,000; and last year it had risen to £2,678,000—and the Committee were still going on borrowing. In 1900, with a capital of £641,000, they made a profit of £9765; whereas last year, with a capital of £2,678,000, they made a profit of £12,000, or less than ½ per cent. on their capital. So that with some £2,000,000 more capital, they made only £3000 more profit. This, at any rate, was sailing perilously near the wind. Only twice in ten years had they made a profit of 1 per cent. on the capital. In his opinion, the amount set aside for depreciation for such delicate, intricate, and short-lived machinery as that employed in connection with the supply of electricity, was altogether insufficient; and he did not think the amount set aside for renewals was at all adequate, having regard to the perishable nature of the plant. Passing to the subject of the unfair cutting-down of prices by the Electricity Committee, Alderman Gibson gave the following instance:

> My attention was first called to it by a builder who sent an order to the Gas Committee for twelve cooking-stoves to be delivered as early as possible at some houses in Chorltonville Estate. This order rather took the wind out of my sails; so I sent for this gentleman to come to see me. He did so, and explained to me that his Syndicate had bought land at Chorlton upon which they proposed to build 400 houses. They had arranged with the Electricity Committee to supply each house with electric current, provided there was no gas in the house at all for lighting. There was to be only one meter, through which all the current should pass, and be paid for by the owner of all the houses; he, in his turn, charging his tenants for electricity in the rent. It came to this: The Manchester Corporation were to supply their commodity at a reduced price for a private individual to retail to his own customers, provided that gas was boycotted altogether. . . . I was indignant beyond measure. It was a most improper, unbusinesslike, and unfair thing to do betwixt one Committee and another, both of the same Corporation. I found also they had made a similar arrangement with another builder of 100 houses. But what hurt me more than anything else was that all this had been done quietly and secretly. The Council knew nothing about it: and I very much suspect there were very few members of the Electricity Committee itself who knew.

Alderman Gibson explained that it was out of respect for Mr. Howarth (the Chairman of the Electricity Committee) that he had said what he had, and what he was going to say, because he did not want to "wash dirty linen" in the Council if he could help it. But he would no longer submit to having the life-blood drained out of the gas undertaking by a process which could only end in failure and disaster to both Mr. Howarth's Committee and his own. He had taken out the names of 34 firms who had paid for gas £10,000 (out of which the Committee made £1000 a year profit), who had become customers of the Electricity Committee. He did not care how many customers that Committee got, if they obtained them on fair terms; but he believed they had been taken by unfair means at cut-throat prices. The Committee were selling at ½d. and ¾d. per unit current which cost 1½d. per unit to produce, just to overtake the capacity of their machinery. Then there was the cost of laying mains to the various customers' premises. Up to last year it cost £32,000. It had cost £7500 to lay mains to the Armstrong-Whitworth works; and it would be interesting to know what they were charged per unit—he had not been able to find out—as then one would be able to form an idea as to what the Committee were likely to make out of their expenditure. He had endeavoured to show that the policy of the Electricity Committee had been a wrong one from its very beginning, and that it had forced the present Committee to become one of expediency. They had been puzzled to know how to make ends meet; and they had in a weak moment yielded to a policy of cutting-down prices in order to get customers—a policy which never had been, and never could be, one which led to success, but always led to failure. During the past ten years, the Gas Committee had paid £500,000 out of their profits towards the relief of the district rates. In the same time the Electricity Committee had paid £38,000; and their liabilities were £653,000 more than those of the Gas Committee. In conclusion, Alderman Gibson said he was quite prepared to let what had passed remain in the oblivion of the past; but he was not prepared any longer to allow a Committee belonging to the same Corporation to injure the Gas Committee, of which he was the Chairman, and of whose interests he was supposed to be the custodian, by selling their commodity at less than cost price, and by adopting a policy of secrecy and concealment.

The LORD MAYOR then called upon Mr. Howarth to offer a few remarks in reply to Alderman Gibson.

Mr. HOWARTH expressed his indebtedness to the Lord Mayor for affording the two Committees an opportunity of meeting together, as they were all desirous of doing their best in the interests of the city. It would not, he said, be possible that day to consider carefully the statements which had been so clearly put forth by Alderman Gibson. He could not, of course, accept them all. He might say, with regard to the Chorltonville matter, to which reference had been made, that as soon as he found there was a difficulty or unpleasantness in connection with it, he set it right at once. [Alderman GIBSON: Certainly.] His Committee wished to do all they possibly could in the interests of the two departments. It was impossible for a Committee of 30 or 35 gentlemen to go into all the details connected with them; but if they had a Sub-Committee of each, with four members of the Finance Committee added as impartial men, he thought they would be able to remove all the difficulties likely to arise. He did not think it would be wise to then attempt to explain or challenge Alderman Gibson's statements. When all the gentlemen concerned were in possession of the information with which the Electricity Committee would be pleased to supply them, they would be able to decide for themselves as to what was right and what was not.

It was then decided to let the matter rest for the present. Prints of Alderman Gibson's speech will be circulated and considered; and then possibly another meeting will be called to discuss the various points raised.

Councillor Howarth Interviewed.

In the course of an interview, following the publication of the report summarized above, Mr. Howarth expressed the opinion that Alderman Gibson did not quite understand the working of the Electricity Department, consequently the statements made by him at the joint conference should be "taken with a grain of salt." The accounts of the Electricity Department would be balanced at the end of March, and would be found quite satisfactory. Mr. Howarth added that there had been, and would be, some competition between the two departments; but this was entirely of a friendly nature, and in the interests of the public and the city. The matters mentioned by Alderman Gibson would be explained fully from a business point of view; and in due time the whole of the facts would be placed before the City Council and the public.

"In the Town Hall," said Mr. Howarth, "you have people taking two opposite views. One section judges a department by the profit it makes; another—and I am one of them—believes that the first duty is to supply what is wanted for the people at absolutely the cheapest rate. You cannot have too much light. If it were possible to supply electricity to Manchester people at 1d. per unit, I would support such a proposal. I think we shall be able to prove to Alderman Gibson's satisfaction that we are taking business precautions in the matter of renewals and depreciation. In my view, and in that of the members of the Electricity Committee, when once we have done this, it is our duty not to think so much of making a big profit to be handed over to the relief of the rates, but to let Manchester business firms and Manchester householders have the quickest and cheapest service of electricity that we can possibly supply. I think we shall both understand one another better before this conference between the two Committees is over. It will be a few weeks before we are ready to meet Alderman Gibson, but I think we shall convince him that the Electricity Committee is composed of men who have sound business instincts."

Street Lighting at Spalding.—It is stated that some improvements are being made in the public lighting of Spalding. The town is lighted by some 300 lamps. Of these, 240 have been converted into the incandescent type; and by the end of April, 250 of them will have been so improved. A saving in the gas consumption is thus made; while the burners give about four times as powerful a light as the old style. The whole of the cost of the lighting of the town is defrayed from the profits of the gas-works.

The Greater Manchester Scheme.—At a special meeting of the Salford Town Council last Wednesday, it was decided, after a long discussion, to appoint a Special Committee to consider the proposal that Salford should amalgamate with Manchester. A Committee of fourteen, inclusive of the Mayor (Alderman Phillips) and the Deputy-Mayor (Alderman Snape), will be selected at the next meeting of the Council to investigate and report as to the advisability or otherwise of Salford being absorbed by Manchester. There were 25 votes for the resolution and 22 against it. One of the chief speakers was Alderman Sir William Stephens. He argued that *ex-parte* statements in favour of or against amalgamation could not be satisfactory at this juncture. Full investigation was necessary; and he favoured the eventual relegation of the question to the people.

ELECTRICITY SUPPLY AT HASTINGS.

At the meeting of the Hastings Town Council on the 20th inst., the Electricity Committee recommended that in all cases in which a consumer or intending consumer agrees to take current for outside lighting by means of high-power metallic filament lamps, ordinary lamps, or otherwise, he should be charged at the scale now in force for outside lighting by means of arc lamps—viz., 4½d. per Board of Trade unit—as registered by a separate meter supplied without charge by the Corporation. The consumer must enter into an agreement to take the current for the purpose for a period of three years; any sum payable in respect of current supplied for this purpose not to be reckoned in calculating the discount of 25 per cent. allowed to certain consumers of current under the scale for ordinary private lighting. The recommendation was adopted.

In connection with this decision, it may be interesting to give a few statistics bearing upon the supply of electricity in the borough in the year ended March 31, 1910. The total quantity of current sold was 731,914 units, and the revenue derived therefrom amounted to £17,627 12s. 11d., or equal to 5·78d. per unit sold. The income from other sources than current represented 0·7d. per unit. The total expenditure (all charges) came to £20,547, or equal to 6·74d. per unit sold. There was consequently a deficit of £2919, or 0·96d. per unit, to be made up from the rates. The current is now sold at the following prices per unit: Ordinary consumers, 6½d.; large consumers, (6½d. less 25 per cent.), 4½d.; outside private arc lamps, 4½d.; power, &c., 2d.; public arc lamps, 4d.; converted street-lamps, 2d. By the sale of current only, an average of 5·08d. per unit was realized; whereas to have made the concern self-supporting—*i.e.*, free of rate aid—it should have produced 6·04d. Commercially, therefore, the only consumers who pay are the ordinary ones, at 6½d. per unit. Attention may be called to the fact that for the current supplied to the public lamps 4d. per unit is charged.

METROPOLITAN WATER BOARD.

Value of Water Storage—The Board and the Thames Conservancy.

The Metropolitan Water Board resumed their meetings last Friday, under the presidency of Mr. E. B. Barnard, the Chairman.

The Water Examination Committee reported that they had received the sixth report of the Director of Water Examination on his research work. In two experiments which he (Dr. A. C. Houston) made by adding an enormous number of typhoid bacilli to raw Thames water (the object being to ascertain the comparative vitality of "cultivated" and "uncultivated" typhoid bacilli after storage), it was found that the typhoid bacillus was dead within one week, and in two other experiments within two weeks. Though the Director was well satisfied with his negative results, he put the matter to the crucial test of drinking half-a-pint of the infected water (which contained initially over 218 million typhoid bacilli in this quantity) on the 24th day from the start of the experiment without any evil effects. [Reference was made to this experiment in the "JOURNAL" for Dec. 20 last.] As the Director pointed out in his report, most persons would consider a "drinking experiment" as much more conclusive evidence of "safety" than any negative results obtained in the laboratory. It required no special technical knowledge to appreciate the great practical importance of Dr. Houston's researches in relation to the present and future water supply of the Metropolis; and the Committee recommended that his report should be circulated to scientific bodies, and copies placed on sale at the central offices of the Board.

A special report was presented by the Works and Stores Committee on the subject of the abstraction of water from the Thames, and the proposed settlement of the dispute in regard thereto between the Board and the Conservators. It was stated that a compromise had been come to, and the result was that litigation between the two authorities would now be abandoned. Certain specified conditions of abstraction of water had been settled. The scheme of payments to the Conservancy for the water abstracted would, for 1910 and 1911, be on the basis of the average of the annual payments made in respect of the period from Jan. 1, 1905, to Dec. 31, 1909, inclusive; from 1912 to 1916, £40,000 per annum; and from 1917 to 1941 and thenceforward, £45,000, so long as no greater quantity of water than an average of 300 million gallons a day during the year was taken from the river. The Committee recommended the Board to approve the terms of the proposed settlement, and also urged them to request the Parliamentary Committee to take the necessary steps to obtain parliamentary confirmation of the proposed settlement, and, further, to express their appreciation of the assistance rendered by the Hon. T. H. W. Pelham, C.B., Assistant-Secretary to the Board of Trade, and Mr. F. J. Willis, Assistant-Secretary to the Local Government Board, which had resulted in an amicable settlement being arrived at. The report was adopted.

Opposition to the Board's Bill.

The Solicitor to the Middlesex County Council views the Board's New Works Bill with grave misapprehension. He has reported to the Council that the effect of the non-incorporation in the Bill of section 127 of the Lands Clauses Consolidation Act, 1845, is that the Board will not be bound to sell and dispose of any surplus lands after the expiration of the ten years limited by the Act; while the non-incorporation of section 133 is a matter which requires very careful consideration. By it, if the Board become possessed of any lands liable to be assessed to the poor rate, which includes the county rate, they are bound from time to time, until the works by the Act authorized shall be completed and assessed to such poor rate, to make good the deficiency in the assessment by reason of such lands having been taken or used for the purposes of the works. The effect of the deletion of section 133 will, the Solicitor says, be that from the time the Board purchase land under the Bill for the purposes of their undertaking, it will cease to be rateable, as it will in all probability be unoccupied, and will not come into rating again until the works have been completed and assessed; and as the period limited for the completion of the works is fixed at 25 years, this may be a very serious matter for the County Council and other rating authorities. Apart from this question, however, is the further one of the rating of the reservoirs, inasmuch as they will only be rated as "land covered by water," and therefore at one-fourth of their proper rateable value. The Solicitor considers that the section ought to be retained and the works rated at their full value.

CHESTER WATER COMPANY'S PROPOSED NEW WORKS.

Scheme Approved by the Shareholders.

A Special Meeting of the Chester Water Company was held at the offices last Tuesday—Mr. F. E. ROBERTS in the chair—for the consideration of the Bill proposed to be introduced next session to authorize the Company to construct new works, and for other purposes.

The CHAIRMAN said the Company's proposals were really to make a large reservoir for the purpose of impounding the waters of the River Dee previous to filtration, and with the idea at the same time of erecting what had been suggested as a second line of defence against any pollution of the water or otherwise. The efforts of the Town Council had been for many years directed towards this object; and they had impressed upon the Company the advisability of having something of the kind to meet the necessities which might from time to time arise from floods or freshets in the river. After careful consideration, the Directors had decided to promote the Bill; and they had reason to believe that its object met with the approval of the citizens in general. Scientific opinion was to the effect that there was no water better as a source of supply than river water properly safeguarded; and the best system was the one they intended to adopt—viz., that of sedimentation. This was the new feature which the Company were introducing in the form of a large storage reservoir, which would treat the water before it reached their filter-beds. He concluded by moving—"That the Bill now submitted, entitled 'A Bill to authorize the Chester Water-Works Company to construct new works, to sanction and confirm the construction of existing works, to raise additional capital, and to consolidate their existing capital, and for other purposes,' be approved, subject to such additions, alterations, and variations, as Parliament might think fit to make therein."

Mr. H. A. LATHAM, in seconding the motion, said the reservoir was recommended by the late Medical Officer of Health for Chester and also by the present one, by Dr. Houston (of the Metropolitan Water Board), by Professor Boyce, and others. The cost of the new works would be about £80,000.

Mr. DUCKWORTH asked if the Company could count upon the complete co-operation of the Town Council.

The CHAIRMAN said they were hoping to be able to do so, because what they were doing was in response to the pressure brought to bear on them by the Corporation. It was not the Company's wish to spend £80,000. The Corporation had felt that some additional safeguard for the water was wanted.

The resolution was carried; and at a subsequent meeting of the preference shareholders, this action was confirmed.

Opposition by Local Authorities.

A conference of clerks, legal advisers, and representatives of the majority of the local authorities having jurisdiction in the watershed of the Dee, was held at Llangollen last Tuesday, under the chairmanship of Mr. J. S. Shaw, J.P. Mr. J. P. Gamon (Clerk to the Chester Rural District Council) said the conference was called to protest against clauses 18 and 19 of the Water Company's Bill, which, he said, seriously infringed upon the sanitary authorities' powers in the watershed of the Dee. Clause 18 might be used to compel the authorities to provide costly sewerage schemes for their districts merely to benefit the Company and their customers. Mr. Grant Bailey (Clerk to the Tarvin Council) remarked that what the Company sought was to control the entire watershed of the Dee from Bala to Chester, and to prevent any local authority turning matter the Company held to be deleterious either into the river itself or into any tributary of it. In the course of the discussion, great indignation at the proposed action of the Company was expressed; and it was decided to petition against the Bill.

High-Pressure Mains in Subways.—At the meeting of the London County Council last Tuesday, the paragraph in the report of the Highways Committee stating that they had granted permission to the Gaslight and Coke Company to lay 6-inch high-pressure mains in the Strand and Aldwych subways, as already noticed in the "JOURNAL" (*ante*, p. 239), was received without discussion.

Lectures to Gas-Fitters.—In the course of the proceedings at the recent annual meeting of the Lancashire County Ironmongers' Federation, Mr. R. Hall, the President of the Ironmongers' Federated Association, referred in approving terms to the scheme put forward by Mr. H. Kendrick, of Stretford, as President of the Manchester District Institution of Gas Engineers, for the delivery of lectures on gas fittings and appliances to workmen engaged in connection therewith. His reason for advocating the scheme was, he said, to make young tradesmen thoroughly competent to do their work, for this would lead to the retention by ironmongers of business which there was now a tendency to filch from them.

Opposition to the Bedwellty Bill.—The Bill of the Bedwellty Urban District Council has been before Mr. Campion, one of the Examiners of Petitions for Private Bills, for proof of compliance with Standing Orders. As mentioned in the "JOURNAL" last week, memorials had been presented complaining of non-compliance. The various allegations were inquired into on the 20th inst., and some of them were sustained. Others were dealt with last Tuesday; but the memorialists failed. The Examiner will therefore report non-compliance, and the Standing Orders Committee will decide whether or not the Bill shall proceed. Should it be allowed to do so, it will be opposed by the Gelligaer Urban District Council.

NEW GAS-WORKS FOR SUTTON-IN-ASHFIELD.

Last Friday, Mr. H. R. Hooper held an inquiry on behalf of the Local Government Board into an application by the Sutton-in-Ashfield Urban District Council for approval of the borrowing of £20,000, and for sanction to the application of the unapplied balance of the sale money arising from the disposal of that portion of the Council's gas undertaking which is situate in the urban district of Kirkby-in-Ashfield for gas-works purposes. The Council were represented by Mr. J. Briggs (the Chairman of the Gas Committee), Mr. J. D. Fidler (the Clerk), and Mr. H. Woodall (of Messrs. Corbet Woodall and Son), the Engineer for the new works. Mr. Fidler explained that the estimated population of Sutton-in-Ashfield at the present time was 22,000, and the assessable value £44,404. The history of the gas-works since they were established in 1852 by a private Company was traced, and figures given relating to the various items of expenditure on the works since they were taken over by the old Local Board in 1878. Though the Kirkby Urban District Council had purchased the portion of the gas undertaking in their parish, it was explained that the demand for gas in the Council's area had greatly increased, and had rendered necessary the provision of new works; while the Sutton Council were now also under agreement to supply the neighbouring parish of Kirkby. Mr. Woodall submitted particulars of the new scheme and the contracts which had been entered into. All the work, he said, would be carried out within the estimates, or would be covered by the figure stipulated for contingencies.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

A report of a most interesting nature has been issued by the Directors of the Coatbridge Gas Company, dealing with the half year ending Dec. 31. The total consumption of gas in the six months amounted to 92,531,276 cubic feet, which was an increase of 1,296,359 cubic feet over the previous corresponding period. The average illuminating power, under the modern system of testing, has been 17·11 standard candles. There has been an increase of 60 in the number of ordinary and prepayment consumers, and of 481 in the number of cooking and heating appliances let out on hire. It is considered satisfactory that not only is gas becoming more popular as an illuminant, but that it is also making steady headway for domestic purposes, more especially by the adoption of effective heating apparatus in place of coal-fires. The gross revenue for gas and residual products amounted to £15,865; and the capital expenditure in the half year was £451. The cost of the new purifying plant was charged to the insurance fund, with the authority of the Sheriff; and the reserve fund was adjusted in terms of the last Provisional Order. The Directors are pleased, after providing in an ample manner for the ordinary maintenance and renewal of all plant, to have been able to still further reduce the price of gas to 1s. 7d. per 1000 cubic feet to ordinary consumers, and proportionately to consumers by automatic meters; and for motive power, to 1s. 4d. per 1000 cubic feet. At the annual ordinary general meeting of the shareholders, the Directors will recommend the payment of dividends, in accordance with the sliding-scale, at the rate of 12 per cent. per annum on the original stock, and 8 $\frac{6}{20}$ths per cent. per annum on the three issues of £10 shares, less income-tax. The reductions are at the rate of 3d. per 1000 cubic feet for lighting, and of 2d. for motive power. Truly in Coatbridge the price of gas is the lowest charged in Scotland—and the lowest by a long way.

I stated in my "Notes" last week, in regard to the action which had been taken by the Town Council of Falkirk against Bailie H. Russell, with reference to his having unauthorized gas connections in his brass-foundry, that Bailie Russell had disputed the right of the Council to impose upon him a modified penalty of £1, and had offered to defend legal proceedings if they should be instituted by the Council. In accordance with a requisition signed by three of the members of the Council, a special meeting was held on Tuesday evening, at which a letter from the Law Agents for Bailie Russell was read. In their letter, they say that they had been consulted by Mr. Henry Russell with reference to the resolution passed by the Town Council on the 19th inst., imposing a penalty upon him of £1 in respect of alleged unauthorized connections with gas-pipes at his works; and that it appeared to them that, in taking upon themselves the imposing of the penalty, the Town Council had acted *ultra vires*, and the resolution was therefore inept. On these and other grounds, it was added, Mr. Russell was prepared, while reserving all other remedies open to him, to defend any proceedings which the Council might take for recovering the penalty—indeed, it was his wish that proceedings with this view should be taken, so that the whole matter dealt with in the resolution could be discussed in a Court of Law. Mr. Sinclair moved that, in view of the terms of this letter, refusing to accept the generous proposal for settlement made by the Town Council, they should withdraw their proposal, and remit the matter to a Committee, with full powers to act as they might consider necessary. After discussion, this proposal was adopted.

In the second of a series of Arnott Lectures on the history and present position of the gas-engine as a power generator, delivered in Gordon's College, Aberdeen, by Mr. Alex. R. Horne, the head of the Engineering Department of the College, the lecturer said that suction-gas producers were now being manufactured which consumed anything of a bituminous nature—coke, brown coal, peat, and even sawdust—for power purposes. For the first few years after the introduction of suction-gas producers, a great deal of doubt existed as to their reliability; but tests which were carried out by the Highland and Agricultural Society showed that, on the whole, the engines ran satisfactorily on producer gas. Another objection taken to producers was that they took a long time to get started up; but in nine out of the ten tests made

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by the Highland and Agricultural Society it was found that 17½ minutes from the start the engine was capable of carrying its full load.

On Friday evening of last week, the ratepayers of the burgh of Oldmeldrum met to consider the position of the gas supply of the town, which is owned by the Municipality. Provost Shand explained that it was proposed to make some alterations, upon which he invited friendly discussion. As they knew, when they acquired the gas undertaking the price of gas was 10s. per 1000 cubic feet. They had hoped that they would have been able to reduce this charge; but they had had to spend a good deal of money in putting things in order, and now, so far as practical working was concerned, the works were equal to any of the same size in Scotland. But in order to reduce the price they must have extra consumption. They wanted people to burn more gas. The gas would have to be put on the rates to a certain extent. It was proposed that, after the next collection, on the 7th of May, the price should be reduced from 10s. to 7s. 6d. per 1000 cubic feet, and that meter-rents should be abolished. If they did this, they could only do it by putting a charge upon the rates. Out of the rates they had been meeting the interest on bonds, and also the sinking fund; and they proposed to rate for the interest and the sinking fund. Interest amounted to £28 a year, and the annual provision for the sinking fund to £12 10s. He was not sure whether the rating could be put upon the owners or the occupiers. There was a discussion upon the proposal, which was altogether favourable to it.

To-day, about sixty students of the East of Scotland Agricultural College paid a visit to the Granton Gas-Works of the Edinburgh and Leith Gas Commission. They were received by Mr. A. Masterton, the Engineer, and were shown over the works. These they viewed with much interest, and particularly the plant for the treatment of residual products.

Melbourne Gas Company.—This Company's agents (Messrs. John Terry and Co.) have received a cable advice from the Metropolitan Gas Company of Melbourne stating that their profits for the half year to Dec. 31 were £93,700. A dividend of 5s. per share has been declared for the half year; a sum of £50,500 has been added to the reserve fund; and the balance carried forward is £2645. Dividends would probably be payable in Melbourne yesterday; and drafts to absentee shareholders will be posted by the first mail this week.

Manchester Water Supply.—The Water-Works Department of the Manchester Corporation, in a report lately issued, show how the water undertaking has developed during the past fifty years. From 1855 to 1860, the average quantity of water supplied per day was 9,720,515 gallons; and from 1861 to 1870, the consumption was at the rate of about 11,783,261 gallons daily. By 1880, the average daily demand on the undertaking had risen to 16,337,030 gallons; and up to 1890, the consumption averaged 19,576,608 gallons. In the succeeding ten years, the quantity supplied worked out at 27,616,166 gallons per diem; and up to 1910, the average each day was 36,092,046 gallons—that for last year being 41,679,085 gallons.

COAL TRADE REPORTS.

Northern Coal Trade.

There is a strong demand in the northern coal trade; but the supply appears to be ample, and, while the shipments are very heavy, the price for some qualities is easier. In the steam coal trade, best Northumbrians are from 9s. 7½d. to 9s. 9d. per ton f.o.b., second-class steams are 8s. 6d. to 8s. 9d., and steam smalls are from 4s. 9d. to 6s. The claims of the Northumbrian miners for a minimum wage are looked on with some uneasiness. In the gas coal trade, the demand is still very full, though there is less pressure than there was a month ago. The usual classes of Durham gas coals vary in price from 8s. 6d. to 9s. 4½ per ton f.o.b.; and for "Wear specials," up to 10s. 6d. is about the current quotation. In contracts, those for the Esbjerg Gas-Works, for 13,000 tons, and for Nyborg, for 3000 tons, for delivery over the season, are in the market; while that for Magona, for about 11,000 tons of good Durham gas coal, has been placed at a price which is believed to be about 16s. 6d. per ton delivered. In coke, the market continues steady. Good gas coke seems to be in full demand, at about 14s. 1½d. to 14s. 6d. per ton f.o.b. in the Tyne or Wear.

Scotch Coal Trade.

Trade is quiet; the foreign demand being very restricted. Splint is in most request. There are plentiful supplies of all sorts. The prices now quoted are: Ell, 9s. 6d. to 10s. per ton f.o.b. Glasgow; splint, 10s. to 10s. 3d.; and steam, 9s. 6d. to 9s. 9d. The shipments for the week amounted to 343,376 tons—an increase of 106,781 tons upon the previous week, and of 38,825 tons upon the corresponding week last year. For the year to date, the total shipments have been 785,499 tons—an increase upon the corresponding period of 68,011 tons.

CURRENT SALES OF GAS PRODUCTS.

[For Table of "Tar Products Prices," see p. 331.]

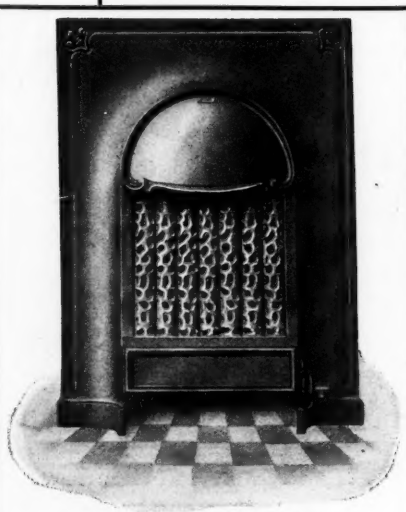
Sulphate of Ammonia. LIVERPOOL, *Jan.* 28.

There has been renewed vigour in the market throughout the week; the tone having been further stimulated by the fact of Japanese buyers, who have hitherto been holding back in the hope of lower prices, having decided to operate at current values. All available supplies have been eagerly competed for; and quotations for prompt delivery now are £13 7s. 6d. to £13 8s. 9d. per ton f.o.b. Hull, £13 8s. 9d. to £13 10s. per ton f.o.b. Liverpool, and £13 11s. 3d. to £13 12s. 6d. per ton f.o.b. Leith. Consumers generally do not show much interest in the forward position; but it is reported that prompt prices have been paid up till April next, and that business has been done at £13 5s. per

Of the making of Gas Fires there is no end,

But experience will ultimately lead you to the best—

THE "D.S.O." SERIES.



The "DEPENDABLE."
10 in. Fire, Black and Fine Cast, **18s.**
Best Berlin Black, **21s.**
Porcelain Enamelled, **28s. 6d.**

FUEL FEATURES.

The Fuel tapers to the top and fits the Flame.

It slopes backwards and, therefore, has a much larger radiation radius than the ordinary Upright Fuel.

The extra length of Fuel (it is the longest Fuel on the market) utilises the heat which with shorter lengths of Fuel escapes up the Flue.

R. & A. MAIN, LIMITED,

WORKS: Gothic Works, EDMONTON, N.; and Gothic Ironworks, FALKIRK.

SHOW-ROOMS: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 56, Broad Street, BIRMINGHAM; 83, Old Market Street, BRISTOL; 13, Whitworth Street West, MANCHESTER; and 333, Queen Street, MELBOURNE.

ton f.o.b. Leith, for equal monthly quantities January-December this year.

Nitrate of Soda.

The market for this article has become rather firmer, and holders have advanced their quotations to 9s. 7½d. and 9s. 10½d. per cwt. for ordinary and refined qualities respectively, on spot.

LONDON, *Jan.* 30.

Tar Products.

The markets for tar products remain very firm. Pitch is decidedly steady, though there has been no material advance in price. Benzol continues very firm. Solvent naphtha is steady. Creosote is quiet. In crude carbolic acid, there has been a certain amount of inquiry; but it is doubtful whether it is genuine, though high prices are reported to have been paid on this side.

The average values during the week were: Tar, 18s. 9d. to 22s. 9d., *ex* works. Pitch, London, 38s. to 38s. 6d.; east coast, 38s. to 38s. 6d.; west coast, Manchester, 37s. to 37s. 6d., Liverpool, 38s. to 38s. 6d., and Clyde, 38s. to 39s. Benzol, 90 per cent., casks included, London and North, 9d. to 9¼d.; 50-90 per cent., casks included, London and North, 9d. to 9¼d. Toluol, casks included, London, 9¾d.; North, 9½d. Crude naphtha, in bulk, London, 3⅜d. to 4½d.; North, 3d. to 3½d.; solvent naphtha, casks included, London, 11½d. to 1s.; North, 10½d. to 11d.; heavy naphtha, casks included, London, 11⅜d. to 1s.; North, 10¾d. to 11d. Creosote, in bulk, London, 2¼d. to 2⅜d.; North, 1⅞d. to 2d. Heavy oils, in bulk, 2⅜d. to 2¾d. Carbolic acid, 60 per cent., casks included, east coast, 1s. 1d. to 1s. 1½d.; west coast, 1s. 0½d. to 1s. 1d. Naphthalene, £4 10s. to £8 10s.; salts, 40s. to 45s., bags included. Anthracene, "A" quality, 1½d. to 1¾d. per unit, packages included and delivered.

Sulphate of Ammonia.

The market for this article is decidedly strong, and there has been a further improvement in price. To-day, actual Beckton is quoted at £13 2s. 6d. Outside London makes are £12 18s. 9d. to £13; Hull, £13 8s. 9d.; Liverpool, £13 10s.; Leith, £13 10s. to £13 12s. 6d.; and Middlesbrough, £13 8s. 9d.

A report of the Main Roads and Bridges Committee adopted by the Staffordshire County Council recommended opposition to the Cannock Gas Provisional Order, with a view to clauses being inserted in the Order for the protection of the county main roads and bridges; to the Chasetown Gas Bill; to the Lichfield Gas Provisional Order, unless the Order gives power to supply gas within the parish of Ogley Hay Rural, and subject to the clause approved by the Committee being inserted; to the Tamworth Gas Bill, with a view to the protection of the county main roads and bridges; and to the Ashbourne and District Gas Bill, also with a view to the protection of the county main roads and bridges.

Electric Lighting in Islington.

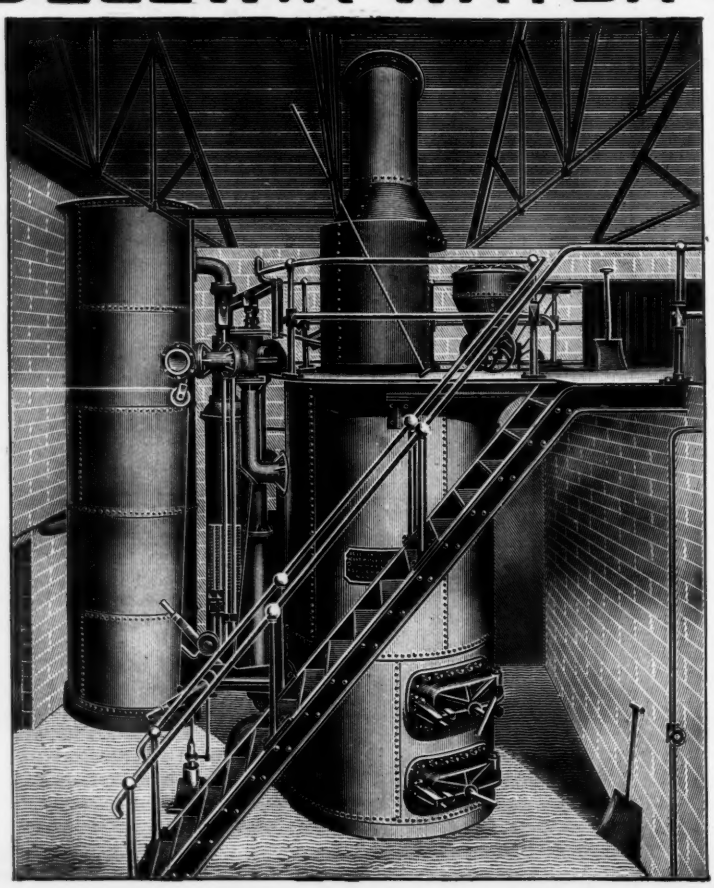
At the meeting of the Islington Borough Council on the 20th inst., Mr. Walsh moved that the Lighting Committee be requested to present a report as to the financial loss sustained by the substitution of high-pressure gas for electricity in the borough, and as to what steps the Committee recommend should be taken for safeguarding the interests of the ratepayers. He said his motion was an endeavour to get at the real position of the undertaking. Alderman Vorley moved, as an amendment, that the Council ask the Lighting Committee to consider the question of the substitution of high-pressure gas for electricity. He held that it was undesirable that every time a customer gave up electricity and reverted to gas it should be advertised all over the borough. They were practically catering for the same customers as the gas companies, and had to give and take. The electricity undertaking had, however, taken more than it had given. When he first went on the Committee, a report was issued showing the number of people giving up electricity; but now this reversion was exceptional. At the same time, these cases occurred, and publicity, as suggested by Mr. Walsh, would enable their competitors to make a great deal of them. Alderman Crole-Rees seconded the amendment, and it was adopted with the addition of the words, "and report what steps should be taken."

Profit-Sharing in Boston (Mass.).—There are now 698 profit-sharers on the books of the Boston (Mass.) Consolidated Gas Company; and a few weeks ago the Directors issued a notice to the effect that it would be advantageous to both the Company and the employees if the latter had a representative on the Board. They therefore invited nominations for the position. Each profit-sharer is entitled to as many votes for a Director as he or she may hold preferred shares in the Massachusetts Gas Companies.

Weston-super-Mare Water Supply.—On behalf of the Local Government Board, Mr. P. M. Crosthwaite has held an inquiry at Weston-super-Mare with regard to an application by the Council for a Provisional Order amending a previous Act and admitting of the construction of additional reservoirs in connection with the water-works. The Clerk (Mr. S. C. Smith) pointed out that the reservoir accommodation of the town had not been increased since 1878, when the population was only 12,000, as against 24,000 to-day.

Tube Trade Combination.—A correspondent of the "Financial News" says: "Such satisfactory progress has been made with the negotiations for the reconstruction of the tube trade combine, that a meeting of those interested will be held in Glasgow shortly, when definite proposals will be submitted. All the larger producers have expressed themselves as favourable in principle to combination, though certain details still remain to be adjusted. Since the International and British Tube Makers' Association collapsed in 1908, a very severe cutting of prices has been in progress. As the demand is now overtaking the supply, competition is held to be useless."

DELLWIK WATER GAS PLANT



WITH

TAR CARBURETTING

IN SUCCESSFUL OPERATION AT PRESCOT AND SNODLAND Gas-Works.

Results Guaranteed.

Full Particulars from

R. & J. DEMPSTER LIMITED, MANCHESTER.

London Office:

165, Gresham House, Old Broad St., E.C.

Sale of Shares.—At a sale by auction by Mr. J. C. Towner on Monday last week, some "A" stock of the Eastbourne Gas Company was sold at the rate of £174 and £174 10s. per £100; and some "B" stock at the rate of £140 10s. and £141 5s. per £100.

Reduction in Price.—The Directors of the Banbury Gas Company have, as from the 1st inst., reduced the price of gas 2d. per 1000 cubic feet, bringing it down to 2s. 10d. Consumers using prepayment meters will participate in the reduction by receiving a cash discount.

Charges for Water at Ilfracombe.—A new scale of charges for water for other than domestic purposes was adopted by the Ilfracombe District Council at their last meeting. The Chairman (Mr. F. W. Drake) stated that if in any instance the new charges were found to be excessive, they could be modified after a year's trial. The Council could not give with certainty any idea of the increased revenue that would result; but the increase, whatever it might be, would go to lower the general water-rate, which was now at its maximum.

Water Question at Southampton.—A poll of the ratepayers of Southampton was taken last Saturday on the question of the purchase of the South Hants Water Company's undertaking; 2684 votes being recorded in favour of the proposal, and 4770 against it—giving an adverse majority 2086. The result was a popular one with the ratepayers, among whom the suggested purchase caused considerable anxiety, with a prospect of an increase of 7d. in the pound in the water-rate for the next twenty years before a reduction could be expected.

Directors Overcome by Gas.—A somewhat sensational report appeared in the "Dublin Evening Telegraph" last Wednesday, to the effect that the Directors of a leading commercial firm in the city were overcome, while transacting their business in the Board-room, by gaseous fumes emanating from the stove used for heating the apartment. It was not alight; and the nature of the gas is not stated. But, according to one of the gentlemen affected (all of whom had recovered by the next day), it was not supplied by the Alliance and Dublin Consumers' Gas Company.

New Water-Works at Exmouth.—Tenders for the construction of the water-works authorized by the Exmouth Water Act of last year were considered by the Exmouth District Council on Thursday. The Sanitary Committee, on the advice of Messrs. Hill and Son, the Engineers, recommended that the tender of the Stanton Iron-Works Company be accepted for the pipes, valves, &c., and that of Messrs. A. C. Potter and Co. for the pumping machinery. The Council confirmed these recommendations, and also accepted the contract of Mr. E. Harris, of Exeter, for the erection of the engine-house and laying the pipes. The total amount of the three tenders is £11,485.

The Electricity Supply Question at Holmfirth.—At the annual meeting of the Holmfirth and District Tradesmen's Association last Tuesday, a deputation was received from the District Council on the subject of the proposed supply of electricity by them, to which reference has already been made in the "JOURNAL." It consisted of two councillors, who were accompanied by Mr. Harry Marsden, the Gas Engineer of the Honley District Council, who is advising the Holmfirth Council. After making a long statement, and giving answers to several questions, Mr. Marsden and the deputation withdrew; and it was resolved to hold a special meeting on Friday to consider the matter.

Merthyr Tydfil Water Scheme.—The Water Engineer of the Merthyr Tydfil Corporation (Mr. T. Fletcher Harvey, M.Inst.C.E.) and their Consulting Engineers (Sir Alexander Binnie, Son, and Deacon, of Westminster) have prepared estimates of the expenditure for permanent works, including works of the second class, land, and contingencies, proposed to be constructed under the powers contained in their Water Bill for the coming session. They are as follows: Purchase of lands, easements, buildings, &c., £50,000; reservoir, including embankments, dams, filter-beds, &c., £213,050; aqueducts, consisting of lines of pipes, £117,911; and road diversions, £19,011—£399,972. The reservoir will intercept the waters of the River Taf Fechan and its tributaries.

Bicester Gas-Purchase Proposal Rejected.—At an adjourned meeting, the ratepayers of Bicester have, by an overwhelming majority, rejected a proposal that the Urban District Council should promote a Bill in Parliament for the purchase of the local gas undertaking. The works have been in possession of the Mid-Oxfordshire Gas Company, now in liquidation, and are stated to have been among the profitable undertakings of the Company. From speeches made, it seems that some of those present were dissatisfied with the way in which the negotiations for the purchase had been conducted, and not antagonistic to the general principle of acquiring the works. The Chairman (Mr. J. W. Hunt), at the close of the proceedings, said he was afraid the ratepayers had lost a "golden opportunity."

Bungay Water Company's Financial Position.—A meeting of the shareholders in the Bungay, Harleston, and Eye Water Company has been called by the Secretary for to-morrow, to consider the Company's position in regard to certain difficulties which have arisen as to the contract for the construction of the wells. It appears that, after a year's working, the subscribed capital has been spent, and the Directors, therefore, have no option but to take the views of the shareholders as to the future course of the Company. The authorized share capital was £18,000; and of this amount the accounts to Dec. 31 last show that £4870 had been issued, of which £1500, in £10 shares, was held by the contractor. In addition, there were debentures to the extent of £1600, on which £40 interest had accrued, but not paid.

Price of Gas at Leigh-on-Sea.—The Gas Committee of the Leigh-on-Sea Urban District Council having recommended that no alteration in the price of gas be made at present, Mr. Taylor moved in the Council that the report be received, but not adopted. He thought an undertaking of this sort should stand on its own feet, and that they ought not to charge more than they were obliged, merely to get large net profits and to pay a sum to keep down the district rate. Mr. Senier seconded; remarking that a reduction was not only due, but could be given without injury to the undertaking. Mr. Watson argued that it was hardly wise to make any reduction under existing circumstances. In his opinion, it would be premature to do so. Mr. Meachen said if the Council would wait a week or two, the Gas Committee would come forward with a definite proposition. The report was then adopted.

The CANNON "RADIO"

Gas-Heated Steam

RADIATOR.

The Radiator for Your Hire List.

CHEAP. EFFICIENT.

NO LEAKY JOINTS, THE LOOPS AND BOILER BEING CAST IN ONE PIECE.

Automatic Air Valve, securing the escape of air from the Tubes as the Radiator heats up.

Automatic Gas Valve for Maintaining an Even Temperature.

Ask for our "Congenial Warmth" Booklet, Free on application.

MANUFACTURERS:—

CANNON IRON FOUNDRIES, LD.

DEEPFIELDS, Nr. Bilston, Staffs., Eng.

London Show-Rooms:—

18, HOLBORN VIADUCT, E.C.

Australasian Agents:—

JAMES HURLL & CO., Ltd., 20, Loftus St., SYDNEY.

Tottenham and Edmonton Gas Company.—At the half-yearly meeting of the Company next Saturday, the Directors will report a sum of £40,223 available for distribution; and they will recommend the payment of the full statutory dividends of 7 and 5½ per cent. per annum. This will leave a sum of £23,736 to be carried forward. There was an increase of 4·54 per cent. in the sale of gas in the second half of last year, compared with the corresponding period of 1909. The consumers now number 56,724; and there are 24,014 cooking and heating stoves in use. The price of gas has been reduced 1d. per 1000 cubic feet, making it 2s. 3d.; and the prepayment consumers receive an additional cubic foot of gas for 1d.

Municipal Profits and Income-Tax.—Addressing the members of the Lancaster Town Council, Mr. Briggs said he had called attention before to the question of income-tax. They paid on gas £665, electricity £170, and water £827—a total of £1663. He thought a corporation should be like co-operative societies. The people who had to pay this money had most of them no liability to pay income-tax at all; and they had a right to demand this 2d. in the pound back again. It amounted to about a 2d. rate. He would like to ask if nothing could be done to obtain a reduction on account of the loss on the trams. There was a loss of about £3000 a year; and while they paid income-tax on the profits of remunerative departments, they got nothing back for the unprofitable ones. Mr. Wright also said he would like to ask the Finance Committee if they could not devise some scheme by which this waste in income-tax could be avoided. They were making this money out of gas consumers—who would have to pay all the bills if there was a deficit—merely to give £2000 or £3000 towards the rates; and then they had to pay income-tax upon it. He contended that the Committee ought to make the best gas they could, and sell it at cost price to the consumers. Then there would be no profits; and the £665 would go to diminish the price of gas.

The New Gas and Coke Company, Rawcliffe and Rawcliffe Bridge, Limited, has been registered with a capital of £5000, in £5 shares, to take over the gas-works belonging to Mr. G. F. Ogle.

The Examining Board of the Incorporated Institute of Hygiene has awarded the Davis Gas-Stove Company a diploma certifying that their stoves have passed the standard of hygienic merit required by the Institute. This is the second year in succession that the Company have received such a certificate.

The list of proposed increases of officials' salaries to be dealt with by the Manchester City Council in March gives a total of £1200. The Gas Committee figure with the modest sum of £65; and the Water Committee have only £100, half of which is a proposed advance to Mr. W. Blackstock, the Secretary to the Committee. There is only a sum of £100 increase recommended, and that is in the case of Mr. T. De Courcy Meade, the City Surveyor.

The name of the "Patent Paraffin Gas Lighting Company," of Glasgow, has (for brevity) been changed to "Paterson's Lighting Limited." The firm was established in 1885 by Mr. Robert Paterson (still the active head of the business) for the supply and erection of plant for making gas from paraffin oil or petroleum for the lighting of country mansion houses, mills, and villages. They now also do a considerable business in acetylene lighting, with plant of the "storage" class.

The *agenda* for to-morrow's meeting of the Manchester City Council contains a resolution, in the name of Mr. Hailwood, asking the Gas Committee to consider and report as to the desirability of giving a larger quantity of gas for 1d. to consumers having their supply through prepayment meters, or of periodically refunding to such consumers a percentage of the present charges. This resolution was in the list for the last meeting of the Council, but had not been reached at the adjournment.

A "Travellers' Conference" has just been held at the Diamond Foundry, Luton, at which the whole of the representatives employed by the Davis Gas-Stove Company were present. The particular business in hand was the inspection and consideration of new gas-fires and improvements in fires and radiators for the next winter season. The success achieved by the Company's specialities during the season now drawing to a close was freely commented upon; but it was thought on all hands that this record could be easily eclipsed by the advances indicated for next season's goods.

The Secretary and Manager of the Folkestone Gas Company (Mr. W. Griffin) gave his annual entertainment to the employees and several of his friends on the evening of the 14th inst. In proposing the health of the Directors, Mr. Griffin mentioned that during the past year the Company had paid in wages to the working men of the North and East Wards no less than £11,000. This showed what a great benefit a large undertaking such as that of the Gas Company must be in a town like Folkestone. The entertainment was repeated to the wives and friends of the employees the following Monday evening.

At to-morrow's meeting of the Leeds City Council, Alderman C. H. Wilson will propose the following: "That the resolution passed by the Council on Sept. 23, 1885, to allow a discount of 5 per cent. upon accounts for gas and water paid within one month of the account being furnished to the consumer, and 2½ per cent. if paid within two months, and the resolution of the same date that the accounts be issued half yearly, be rescinded; and that the Council resolve that from and after June 30, 1911, a discount of 5 per cent. be allowed upon accounts for gas and water paid within one month of the account being furnished to the consumer, and that such accounts be issued quarterly."

We have received from Messrs. Firth Blakeley, Sons, and Co., Limited, of Thornhill, Dewsbury, a copy of their new preliminary catalogue, a complete and larger edition of which they purpose issuing next year. It contains a plan of gas-works for a make of from 8 to 10 million cubic feet per annum, views of works erected by the firm at Keady and Hathersage, and of their regenerative and other settings, condensers, washers, purifiers, gasholders, and other plant. The particulars furnished show that the firm are determined to keep their manufactures and business well to the front. They have special facilities for catering for the smaller gas undertakings; and evidence of this was afforded by the number of contracts carried out last year.

MAUGHAN'S
"SIMPLICE"
GEYSER
No. 2B.
WITH
ATMOSPHERIC BURNER.

EXTREMELY EFFICIENT,
VERY DURABLE,
LOW PRICE.

Specially suitable for Hiring Out.

May we send you Full Particulars?

THE
PARKINSON STOVE CO., LTD.
(Incorporating Maughan's Patent Geyser Co.),
STOUR STREET, SPRING HILL, BIRMINGHAM,
&
129, HIGH HOLBORN, LONDON.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.
AGENT (LAMP MANUFACTURER'S). No. 5353.
DRAUGHTSMAN. C. & W. Walker, Limited, Donnington.
DISTRICT GAS SUPERINTENDENT. No. 5351.
DISTRIBUTING FOREMAN. Rhymney and Aber Valleys Gas and Water Company.
ENGINEER (FRENCH) FOR TAR DISTILLATION. No. 5352.
GAS-FITTER. Lisburn Gas Department. Applications by Feb. 14.
REPRESENTATIVE. No. 5349.

Plant, &c. (Second-Hand), For Sale.
KEITH'S AUTOMATIC GAS COMPRESSOR AND LAMPS. Tonbridge Gas-Works.

Meetings.
CHIGWELL, LOUGHTON, AND WOODFORD GAS COMPANY. Gas-Works. Feb. 15. Three o'clock.
GASLIGHT AND COKE COMPANY. Chief Office, Feb. 10, Twelve o'clock.
SOUTH SUBURBAN GAS COMPANY. De Keyser's Hotel Feb. 17. Three o'clock.

Stocks and Shares.
CHIGWELL, LOUGHTON, AND WOODFORD GAS COMPANY. By Auction. Feb. 14.
EPPING GAS COMPANY. By Auction. Feb. 14.
GREAT YARMOUTH WATER COMPANY. By Auction. Feb. 14.

Stocks and Shares—*continued.*
MAIDENHEAD WATER COMPANY. By Auction. Feb. 14.
SOUTHAMPTON GASLIGHT AND COKE COMPANY. By Tender. Feb. 28.
SUNDERLAND AND SOUTH SHIELDS WATER COMPANY. By Auction. Feb. 22.
WALTHAM ABBEY AND CHESHUNT GAS COMPANY. By Auction. Feb. 14.

TENDERS FOR

Carburetted Water-Gas Plant.
NEW MILLS GAS DEPARTMENT. Tenders by Feb. 14.

Coal.
ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY.
ASHFORD (KENT) URBAN DISTRICT COUNCIL. Tenders by Feb. 16.
MILFORD HAVEN URBAN DISTRICT COUNCIL. Tenders by Feb 8.
NELSON GAS DEPARTMENT. Tenders by Feb. 13.
SOUTH STAFFORDSHIRE WATER COMPANY. Tenders by Feb. 13.

Filters (Mechanical).
NEW MILLS WATER DEPARTMENT. Tenders for Feb. 14.

Fire-Clay Goods.
HALIFAX GAS DEPARTMENT. Tenders by Feb. 8.

General Stores (Paint, Oil, Tallow, Waste, Iron and Steel, Asbestos Goods, Tools, Valves and Cocks, &c.).
DEVONPORT GAS DEPARTMENT. Tenders by Feb. 11.
HALIFAX GAS DEPARTMENT. Tenders by Feb. 8.
STOCKTON-ON-TEES CORPORATION. Tenders by Feb. 10.

Lighting and Extinguishing Apparatus.
TENDRING HUNDRED WATER WORKS COMPANY.

Mantles, Rods, &c.
CALCUTTA CORPORATION. Tenders by Feb. 28.
DEVONPORT GAS DEPARTMENT. Tenders by Feb. 11.

Meters.
HALIFAX GAS DEPARTMENT. Tenders by Feb. 8.

Oxide of Iron (New and Spent).
HALIFAX GAS DEPARTMENT. Tenders by Feb. 8.

Pipes, &c.
DEVONPORT GAS DEPARTMENT. Tenders by Feb. 11.
HALIFAX GAS DEPARTMENT. Tenders by Feb. 8.

Sulphuric Acid.
HALIFAX GAS DEPARTMENT. Tenders by Feb. 8.
NELSON GAS DEPARTMENT. Tenders by Feb. 13.

Tar and Liquor.
NELSON GAS DEPARTMENT. Tenders by Feb. 13.

TAR PRODUCTS PRICES.

Representative manufacturers give the following as fair current values for the week ending Jan. 28. Prices are net, and they include the usual packages and delivery f.o.b., f.a.s., or f.o.r., as customary.

Article.	Basis.	London.	North-East Coast.	East Coast, Yorks.	West Coast. Liverpool.	West Coast. Manchester.	Glasgow.
Tar crude	per ton	22/6	19/6 22/6	19/6 23/-	18/6 22/6	20/- 22/6	—
Pitch	,,	38/- 39/-	38/-	37/6	38/	37/6	38/-
Benzol, 90 %	per gallon	-/10½	-/9¼	-/9	-/8¾	-/9¼	-/10
Benzol, 50-90%	,,	—	-/10	-/9¼	-/9¼	-/9¼	—
Toluol, 90%	,,	—	-/9¼	-/10	-/10	-/9¾	-/10
Crude naphtha, 30%	,,	—	-/3¼	-/3½	-/3½	-/3¾	-/3¾
Light oil, 50%	,,	—	-/3½	-/3½ -/3¾	-/3 -/3¼	-/3¼	—
Solvent naphtha, 90-160	,,	—	-/10½ -/11	-/10	-/10	-/11¼	-/11⅛
Heavy naphtha, 90-190	,,	—	-/11	-/11½	-/11 -/11¾	-/11¼ 1/-	-/11⅛
Creosote in bulk	,,	-/2½ -/2¾	-/2 -/2¼	-/2	-/2 -/2⅛	-/2 -/2⅛	-/1⅞
Heavy oils	,,	-/3¼	-/2½ -/3	-/2¼	-/2¾	-/2¼ -/3	-/3
Carbolic Acid, 60's	,,	1/2½	1/- 1/1	1/2	1/1	1/1	1/1½
Naphthalene, crude drained salts	per ton	—	42/6 45/-	40/- 42/6	47/6	47/6 50/-	—
,, pressed	,,	—	60/-	63/-	60/-	60/- 72/6	—
,, whizzed	,,	—	—	—	70/- 72/6	60/- 75/-	65/-
Anthracene	per unit	-/2	-/1⅜	-/1½	-/1¼	-/1¼	—

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 283.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.	Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.	£			p.c.				£ s. d.
1,551,868	Stk.	Oct '4	5	Alliance & Dublin Ord.	81—84	..	5 19 1	4,940,000	Stk.	Nov. 11	9	Imperial Continental	185—187	..	4 16 3
374,000	Stk.	an. 13	4	Do. 4 p.c. Deb.	94—96	..	4 3 4	1,235,000	Stk.	Aug 12	3½	Do. 3½ p.c. Deb, Red.	94—96	..	3 12 11
200,000	5	Oct. 28	7	Bombay, Ltd.	6¾—7	..	5 0 0	200,242	Stk.	Aug. 31	6	Lea Bridge Ord. 5 p.c.	122—124	+1	4 16 9
40,000	5	,,	7	Do. New, £4 paid	5—5¼	..	5 1 10	561,000	Stk.	,,	10	Liverpool United A	220—222	..	4 10 1
50,000	10	Aug. 31	15	Bourne- } 10 p.c.	28½—29½	..	5 1 8	718,100	,,	,,	7	Do. B	164—165	..	4 4 10
311,810	10	,,	7	mouth Gas } B 7 p.c.	16½—16⅝	..	4 3 7	306,083	,,	Dec. 30	4	Do. Deb, Stk.	102—104	..	3 16 11
75,000	10	,,	6	and Water } Pref. 6 p.c.	14¾—15¼	..	3 18 8	75,000	5	Dec. 15	6	Malta & Mediterranean	4⅜—4¼	..	6 3 1
380,000	Stk.	Aug. 12	12½	Brentford Consolidated	254—257	..	4 17 3	560,000	100	Oct. 1	5	Met. of } 5 p.c. Deb.	100—102	..	4 18 0
330,000	,,	,,	9⅜	Do. New	198—201	+2	4 14 6	250,000	100	,,	4½	Melbourne } 4½ p.c. Deb.	100—102	..	4 8 3
50,000	,,	,,	5	Do. 5 p.c. Pref.	120—122	..	4 2 0	541,920	20	Nov. 11	3½	Monte Video, Ltd.	12½—12⅝	..	5 9 10
206,250	,,	Dec. 15	4	Do. 4 p.c. Deb.	98—100	..	4 0 0	1,775,892	Stk.	July 28	4⅜	Newc'tle & G'tesh'd Con.	101½—102½	..	4 5 4
220,000	Stk.	Aug. 31	11	Brighton & Hove Orig.	218—221	..	4 19 7	529,435	Stk.	Dec. 30	3½	Do. 3½ p.c. Deb.	89— 90	..	3 17 9
246,320	,,	,,	8	Do, A Ord. Stk.	158—161	..	4 19 5	55,940	10	Aug. 31	7	North Middlesex 7 p.c.	13⅜—14⅜	..	4 16 7
469,000	20	Sept. 29	10⅝	British	44—45	..	4 14 5	300,000	Stk.	Nov. 30	8	Oriental, Ltd.	137—139	..	5 15 1
109,000	Stk.	Aug. 14	6	Bromley, A 5 p.c.	119—121	..	4 19 2	60,000	5	Sept. 15	8	Ottoman, Ltd.	6⅜—6⅝	..	5 18 6
165,700	,,	,,	4½	Do. B 3½ p.c.	89— 91	..	4 16 11	31,800	53	Aug. 31	13	Portsea Island A.	133—135	..	5 1 8
82,278	,,	,,	5½	Do. C 5 p.c.	109— 111	..	4 19 1	60,000	50	,,	13	Do. B.	126—128	..	5 1 7
55,000	,,	Dec. 30	3½	Do. 3½ p.c. Deb.	84—86	+1	4 1 5	100,000	50	,,	12	Do. C.	119—121	..	4 19 2
250,000	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	95—97	..	4 2 6	114,800	50	,,	10	Do. D and E.	103—105	..	4 15 3
100,000	10	—	—	Cape Town & Dis., Ltd.	3—4	..	—	392,490	5	Oct. 28	7	Primitiva Ord.	7⅜—7⅝	..	4 11 10
100,000	10	—	—	Do. 4½ p.c. Pref.	5½—5⅝	..	—	796,980	5	Dec. 30	5	Do. 5 p.c. Pref.	5⅛— 5⅜	..	4 10 11
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.	—	..	—	488,900	100	Dec. 1	4	Do. 4 p.c. Deb.	95—97	..	4 2 6
100,000	Stk.	Dec. 30	4½	Do. 4½ p.c. Deb. Stk.	88 -90	..	5 0 0	312,650	Stk.	Dec. 30	4	River Plate 4 p.c. Deb.	95—97	..	4 2 6
157,150	Stk.	Aug. 12	5	Chester 5 p.c. Ord.	109½—111½	..	4 9 8	250,000	10	Sept. 29	9	San Paulo, Ltd.	15⅛—15⅜	..	5 14 3
1,513,280	Stk.	,,	5⅛	Commercial 4 p.c. Stk.	112—115	+2	4 10 4	115,000	10	,,	6	Do. 6 p.c. Pref.	11⅛—12⅛	+⅛	4 18 0
560,000	,,	,,	5	Do. 3½ p.c. do.	107—109	+2½	4 11 9	125,000	50	Jan. 3	5	Do. 5 p.c. Deb.	50—51	..	4 18 0
475,000	,,	Dec. 15	3	Do. 3 p.c. Deb. Stk.	77—79	..	3 15 11	135,000	Stk.	Aug. 31	10	Sheffield A	231—233	+2	4 5 10
800 000	Stk.	,,	4	Continental Union, Ltd.	89—92	+1	4 7 0	209,984	,,	,,	10	Do. B	231—233	+2	4 5 10
200,000	,,	,,	7	Do. 7 p.c. Pref.	134—136	..	5 2 11	523,500	,,	,,	10	Do. C	231—233	+2	4 5 10
492,270	Stk.	—	5½	Derby Con. Stk.	122—124	..	4 8 9	70,000	10	Oct. 14	6	South African	10⅛—11	..	5 9 1
5,000	,,	—	4	Do. Deb. Stk.	104—105	..	3 16 2	6,429,895	Stk.	Aug. 12	5/9/4	South Met., 4 p.c. Ord.	121—123	..	4 8 10
148,995	,,	Oct. 14	5	East Hull 5 p.c. Ord.	103—105	..	4 15 3	1,895,445	,,	Jan. 13	3	Do. 3 p.c. Deb.	78½—80½	..	3 14 6
486,092	10	Jan. 27	12	European, Ltd.	23¾—24¼*	..	4 19 0	209,820	Stk.	Aug. 31	8	South Shields Con. Stk.	155—157	..	5 1 1
354,060	10	,,	12	Do. £7 10s. paid.	18—18⅜*	..	4 17 3	605,000	Stk.	Aug. 12	5⅝	S'th Suburb'n Ord. 5 p.c.	120—1	..	4 12 9
16,179,445	Stk.	Aug. 12	4⅜	Gas } 4 p.c. Ord.	107—108	+⅛	4 6 4	60,000	,,	,,	5	Do. 5 p.c. Pref.	120—122	..	4 2 0
2,600,000	,,	,,	3½	light } 3½ p.c. max.	87— 89	+1	3 18 8	117,058	,,	Jan. 13	5	Do. 5 p.c. Deb. Stk.	1—1	+2	4 0 8
4,002,235	,,	,,	4	and } 4 p.c. Con. Pref.	103—105	..	3 16 2	502,310	Stk.	Nov. 11	5	Southampton Ord.	110—112	..	4 9 3
4,531,705	,,	Dec. 15	3	Coke } 3 p.c. Con. Deb.	78—80	..	3 15 0	120,000	Stk.	Aug. 12	7	Tottenham } A 5 p.c.	143—145	+2	4 16 7
258,740	Stk.	Sept. 15	5	Hastings & St. L. 3½ p.c.	94—56	+1	5 4 2	483,940	,,	,,	5½	and } B 3½ p.c.	115—117	+2	4 14 0
82,500	,,	,,	6⅛	Do, do. 5 p.c.	114—116	..	5 12 1	149,470	,,	Dec. 15	4	Edmonton } 4 p.c. Deb.	58 100	+3	4 0 0
70,000	10	Oct. 14	11	Hongkong & China, Ltd.	17⅞—17⅞	+⅛	6 4 0	182,380	10	Dec. 30	8	Tuscan, Ltd.	9—9⅛	..	8 8 6
131,000	Stk.	Sept. 15	7⅜	Ilford A and C	146—149	..	4 19 0	149,900	10	Jan. 3	5	Do. 5 p.c. Deb. Red.	98— 100	+1	5 0 0
65,780	,,	,,	5⅛	Do. B	115—117	..	5 0 5	236,476	Stk.	Aug. 31	5	Tynemouth, 5 p.c. max.	114—115	..	4 6 11
65,500	,,	Dec. 30	4	Do. 4 p.c. Deb.	96—98	..	4 1 8	255,636	Stk.	Aug. 31	6¾	Wands- } B 3½ p.c.	142—144	..	4 13 7
								85,766	,,	Dec. 30	3	worth } 3 p.c. Deb. Stk.	73—75	..	4 0 0

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